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The National Defence Contribution

THE most extraordinary thing about the Budget which Mr. Chamberlain opened in the House of Commons on Tuesday is that the amount to be found is the largest ever demanded of the nation in time of peace, and nobody had a word to say about it. The expenditure contemplated by the Government in the coming financial year reaches the stupendous total of £862,848,000, and Mr. Chamberlain's expectation plainly was that the figure would be higher still for 1938-9.

The total has been considerably swollen by the new and wholly necessary defence programme, but that is not the whole story. The cost of the Civil Departments is heavier than it ever was before, and no less than £60,000,000, which Mr. Chamberlain himself has saved by his policy of debt redemption, has been swallowed up by the torrent of rising expenditure. It would almost seem as if Parliament had dropped "economy" from its vocabulary. The position is to some extent cloaked to-day by a rising trade curve and an expanding national revenue, but when the tide turns, the need of economy will be felt acutely. It was because the State was regarded as not being subject to the ordinary canons of finance that the crisis of 1931 broke upon the country with unprecedented violence. If the nation is to be spared a repetition of that disaster, somebody will have to restart the economy campaign and press it to a successful end.

Granted these exceptional figures and the absence of serious criticism on their volume, Mr. Chamberlain's proposals for new taxation are what might have been expected of him. When he raised the income tax by threepence last year, he was clearly leaving himself another threepence to play with at an early date. The return of the income tax figure to five shillings in the pound had been discounted in advance, and it was already governing the calculations of big and small folk alike for the coming year.

Equally, no surprise could have been felt at Mr. Chamberlain's decision to make good part of his prospective deficit by taxing the increased profits which would be the probable result of the Government's huge rearmament programme. What was unexpected was the novel character of his scheme for extracting what is to be called the National Defence Contribution. This is an entirely new tax on trade, for it will not apply to the salaries of professional men or persons in employment. It is a tax on all firms, and not merely on those directly or indirectly supplying the Government with its new defensive weapons. It bears some resemblance to the Excess Profits Duty levied during the war, and that the Treasury means business is shown by Mr. Chamberlain's calculation that whereas it will bring in only £2,000,000 in the first year, the amount will rise to between £20,000,000 and £25,000,000 in the following year. There is no need to go into the details of a complicated proposal, but the principle should be kept clearly in mind, that of a graduated toll on the growth of profits.

The new tax is open to criticism at many points. One of its worst features is that the trade and industry of the country will be subject to far greater official supervision than has ever before been known. A body of Treasury assessors will be set up to determine the liability of every business to this special tax. The Government accountant will step in to check the traditional freedom of the private counting house. Accountants and lawyers indeed will go on their way rejoicing, while the manufacturer and trader are giving them valuable time which ought to be employed in developing their businesses. The proposal is dangerous in giving new powers to the already swollen bureaucracy, and may ultimately lead to a position which would not meet with Mr. Chamberlain's approval. He recommended it deliberately as a strictly temporary tax and declared that its duration would depend upon the duration of rearmament. Another type of Government might not think the same way. There are elements in the political life of this country which are strongly in favour of a permanent supervision of business finance for the avowed purpose of ever-steepening taxation. Finding the machinery ready to their hands, they might use it to make further encroachments on the principle of private enterprise on which the great industries of Great Britain have been built up.

These, and many other aspects, of the most critical Budget proposal, will now have to run the gauntlet of the House of Commons. It will be for the business community to keep its Parliamentary representatives up to the scratch and to be ready with alternative suggestions, for it has to be recognised in a practical world that the money has to be raised somehow. It may even prove after reflection and discussion that Mr. Chamberlain's scheme is the most equitable that could have been devised and is, for example, preferable to higher rates of existing taxation.

When the Budget has been hammered out into its final form, there will be few business men who will not endorse a hearty vote of thanks to the present Chancellor of the Exchequer. This is Mr. Chamberlain's last Budget, for it is an open secret that in a few weeks' time he will succeed Mr. Baldwin as Prime Minister. He has earned the reversion of the greatest office in the State by one of the most remarkable series of Budgets

in British financial history. His steadiness and strength during an extraordinarily difficult period have been vitally important in restoring this country's prestige, no less than its power. A proposal of his here and there may have been open to criticism, but on the whole he has insisted on an orthodox treatment of the nation's financial problems which gives him a secure place among the great Chancellors of the Exchequer.

Notes and Comments

New I.C.I. Records

IMPERIAL CHEMICAL INDUSTRIES, Ltd., whose tenth annual meeting will be held next week, established many new records in 1936, chief of which was a net income of £7,203,329. This is the first time the figure has exceeded seven millions, and the year's total is considerably more than double the corresponding figure for 1931. Income tax (provided for out of gross income) is shown at £846,093, against a mere £260,395 in 1931. Ordinary dividend is maintained for the third year in succession at 8 per cent., the same as for the first three years of the company's activities. Every one of the company's ten operating groups had a prosperous year, and it is satisfactory to note that the cordial relations between the management and its co-workers have been maintained. It cannot be denied that the company owes much of its progress to the recognition of the importance of research. Not only has the company's research work been maintained on an undiminished scale; a new laboratory has been found necessary for the metal group and a similar development is now taking place in the dyestuffs group, where activities are being extended to new branches of the organic chemical industry. Reorganisation and extension has also been effected at the agricultural research station at Jealott's Hill.

Government and Oil from Coal

CAPTAIN CROOKSHANK'S announcement in the House of Commons on Monday that the Government has decided to explore the commercial possibilities of the oil from coal industry will be received with general satisfaction, not only by those who have been developing the industry in recent years, but by those who have taken the view that the existing processes—low temperature carbonisation and hydrogenation—are incapable of meeting the national requirements to any vital extent. Only last week Mr. J. P. Dickie advocated the establishment of an independent oil from coal board, and although the Government proposal does not go as far as Mr. Dickie contemplated, it does at least indicate that the Government is anxious to have more information. A new committee functioning under the Imperial Defence Committee will examine the various processes and report on the economic possibilities and advantages to be obtained by way of security of oil supplies in an emergency. While considerations of national defence are mainly responsible for the decision, Captain Crookshank made it clear that the normal commercial aspects are to be brought under review by the committee. It is not for us to anticipate the findings of the committee, but in the event of it being found that the industry is one that needs and deserves to be encouraged the way will be opened for the establishment of a more permanent research authority on the lines suggested at the Royal Society of Arts last week.

Society of Chemical Industry Medallist

THE Council of the Society of Chemical Industry has made a wise and popular choice in awarding its 1937 medal to Professor G. G. Henderson, Regius Professor of Chemistry at Glasgow University. The medal, which is one of the highest awards in the chemical world, is presented every alternate year for conspicuous service to applied chemistry. Professor Henderson began a life-long association with teaching in 1884, when he became assistant to the Professor of Chemistry at Glasgow University. In his notable academic career he has had a wide experience of examining work, having held the post of examiner in the Universities of Glasgow, Aberdeen, St. Andrews, Liverpool and Belfast. He also possesses the unique distinction of having been president of the Chemical Society, the Institute of Chemistry and the Society of Chemical Industry. For a number of years he was one of the secretaries of Section B of the British Association, in 1905 he became recorder, and in 1916 president. Much time and energy has been devoted by Professor Henderson to the prosecution of original research—mostly in the organic field and particularly the chemistry of terpenes—and to the supervision of the research work of students. Other recipients of the Society's Medal during the past few years include Dr. E. F. Armstrong, F.R.S., Professor W. A. Bone, F.R.S., Dr. Herbert Levinstein and Sir Richard Threlfall, F.R.S.

Air Raid Precautions

CHEMICAL manufacturers in common with other industrialists have been invited to co-operate in drawing up schemes for the protection of personnel and plant from air damage in the event of war. It is, however, being realised that the question of cost is a great difficulty, and the Federation of British Industries has taken the matter up with the Chancellor of the Exchequer on the ground that the establishment of precautions is a national service and should be paid for, at least in part, from public funds. It is not unnatural for businesses whose resources in many cases are limited, to be reluctant to postpone promising developments in favour of air protection schemes which may never be required, where the whole burden has to be borne by themselves. Unless some assistance is given, manufacturers will in most cases not be allowed to charge this expenditure as a business expense for income tax purposes, and many of the protective measures recommended will also lead to actual increase in annual rates. Lack of information as to the intention of the Government is causing delays in the making of arrangements, and an early statement from the Chancellor on the subject would be helpful in accelerating preparations. This suggestion is put forward with the object of assisting the Government, since the Federation is convinced that the question of cost is proving a serious deterrent in this matter.

The Laboratory in the Training of Chemical Works Employees

By F. SHERWOOD TAYLOR, Ph.D., M.A., B.Sc.

EVERY chemist, whether he is to engage in pure research, in school teaching or in works practice, receives substantially the same training, which is intended to give him a general acquaintance with the fundamentals of the science. Inorganic, organic, physical and analytical chemistry, with a glance at the history of the subject, and a smattering of chemical French and German make up the usual course. Although no chemists, with the possible exception of the teacher, uses more than a fraction of what he learns at the University, almost all of the work is relevant to the needs of some type of chemical worker. I have heard the chief chemist of a paint works say "I can get dozens of men who can tell me all about Van der Waal's equation, but I've a job to find anyone who knows how to wash a precipitate."

Some of the theoretical chemistry of to-day sounds remote enough from works practice; but the theory of to-day makes the practice of to-morrow, and we are not educating the chemists of to-day, but those of the next quarter-century. The co-ordination compounds of tripyridyl seem, at first sight, a long way from the world of industry, but in a few years time such compounds may be the foundation of analytical methods or even of the purification of the rarer metals. It is difficult to contemplate any radical alteration of the scope of University courses, but to the method of study great exception may well be taken.

Problems to Solve

The works chemist has to solve problems. Routine analyses can usually be carried out by unqualified assistants: a process when going smoothly needs but a minimum of initiative for its maintenance. The reason for employing highly-trained chemists is that they shall be able to use knowledge, ingenuity and resource, in finding out means of accomplishing new technical achievements and of discovering and eliminating sources of trouble in established processes.

How far does the present system of education fit them for these difficult tasks? The chemist-to-be listens to lectures —sometimes to four in a morning—and copies down elaborate notes to be learnt later. In most college courses the student strays but little beyond the text-book and lecture-notes, and has but rare recourse to the original papers on which these are founded. Consequently, after he has qualified, he has little idea of how to find a fact. Few students learn more than the minimum of German, that most necessary language which, as a rule, is learnt only by those driven to read it. The lecturer, whose notes are copied, would be the last person to claim infallibility and the notes on his lectures, as copied by his hearers, form inaccurate and unbalanced summaries of what he has said. It is not untrue to say that teaching by lecture is the relic of a barbarous age, when books were rarities.

In the laboratory the method of teaching is not much better. In an average course the percentages of time allotted to the different branches might be:—Qualitative inorganic analysis, 20 per cent.; qualitative organic analysis, 10; inorganic preparations, 10; volumetric analysis, 20; gravimetric analysis, 5; organic preparations, 10; physico-chemical measurements, 15.

The distressing feature of the work is that it is almost all based on a mechanical following of text-book directions, and that all the experiments are picked to "come out." Not a spark of ingenuity is required, except perhaps in the detection of organic "spots"—in itself a highly artificial form of exercise. It may well be that throughout the whole course not a single problem is solved. A year's research often follows the final B.Sc. examination. This research may be of infinite value if it is such as to present a wide range of varied problems: if it involves only the making of a long series of stereotyped measurements, it may be time largely wasted. Moreover, if the time for it is gained by compressing a three years' course into two years, the student is likely to be crammed rather than taught.

What remedy have we for this regrettable state of affairs? I would not advocate the adoption of a completely heuristic system, for the student of to-day has so much to learn that he has not time to re-create a science for himself. I would say—let the student learn and make him use his wits. There is, as it were, a Principle of Least Action in psychology which causes us to avoid thinking of a high order, where thinking of a lower order will suffice. As long as the student can copy notes and follow text-book directions, he will not work out a systematic survey of a subject nor plan a practical method.

Abolition of Lectures

In reforming our system I would first abolish the lecture, except perhaps as a means of letting the student, on rare occasions, see that famous men are only life-size and often very dull. Eighty per cent. of the matter of a course of thirty lectures can be found in standard text-books. The true function of the university teacher is to present his view of new or disputed problems. He should, therefore, prepare, instead of lectures, a number of surveys of doubtful or difficult matters; these should be duplicated and distributed to the students, who would thus receive a clear and balanced statement of matters in which they needed help.

The abolition of lectures in the college with which I am best acquainted would provide about 15 "man-hours" weekly which could be utilised for personal teaching. This would give every pair of students an hour a fortnight with a member of the staff. I would adopt the system of the older universities and require each student to produce once a fortnight an essay dealing with some important aspect of chemistry. The hours now occupied in copying down lecture-notes would be used to prepare these essays. Their compilation would compel the student to acquaint himself with the literature of the subject, to learn to use a library and above all to learn to prepare a coherent report from a mass of heterogeneous material.

Spoon-fed Students

The same artificiality and spoon-feeding prevails in the practical work which students perform. Let me examine the work done in the usual degree course. Qualitative analysis comes first. In works practice or indeed in research, this is likely to take two forms. First, minute traces of one radicle may be sought for—say, 10 parts of lead per million of a drug or foodstuff; secondly, a highly complex mixture, *e.g.*, a mineral—which may contain any proportion great or small, of any element rare or common may require analysis. The student is never asked to detect minute traces of anything: the mixtures he analyses rarely contain less than 2 or 3 per cent. of the materials sought, and are chosen from a quite arbitrarily limited field of radicles, including only twenty-two metals. I would recommend an extended system of analysis to be carried out, not on artificial mixtures but on actual minerals.

The teaching of volumetric and gravimetric analysis is on a sounder basis, but the practice, let us say, of determining the proportion of iron in A.R. ferrous sulphate is a highly artificial one. It would be far more useful to determine the proportion of iron, copper, tin, etc., in an analysed sample of, say, Delta metal, for in practice almost all analyses have to be preceded by a separation. Almost all students have, at school, performed simple estimates, and at least understand

the general principles; let them do something progressive and learn something of materials which exist outside the laboratory.

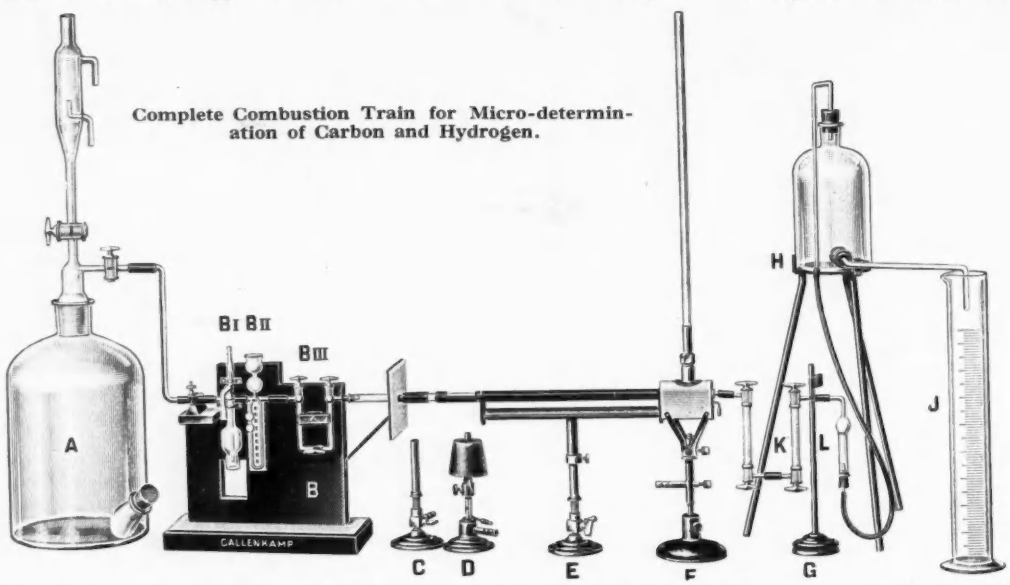
The organic and inorganic courses are better conceived, but consist, as a rule, too exclusively of preparative work. The organic preparation and "spot" could be, at least in a part of the course, combined in questions of the type "Investigate the reaction between A and B, under conditions specified. Isolate, purify and identify the product." In the physical chemistry course, too, less measurement of known quantities and more experiments involving a little contrivance are required.

How lamentably lacking in contrivance is the modern student—not through his own fault. Twenty per cent. of the students who reach the college have never bored a cork and cannot make a smooth bend in a piece of glass tubing. Of the students who leave the university, the majority cannot be sure of blowing a T-piece successfully; many have the crudest notions about fitting up apparatus capable of excluding air and moisture. Why is this condition, contrary to the spirit of experimental science, so prevalent? Because our theoretical examinations demand a vast equipment of facts and because our practical examinations do not require more than minor variations on routine themes. Remodel our examinations so as to pick out the ingenious and resourceful worker and the deeply read in some few parts of our science. In the practical examinations, set questions of widely varied type and requiring both resource and manipulative skill. In the theoretical papers, first require very high marks in a qualifying examination of rather simple type in order to make sure that candidates are well grounded. Then give a wide choice of questions in our advanced papers. In correcting these latter, give no credit for a knowledge of a few facts so put down as to betray a lack of understanding, but the highest credit for even two questions showing the fruit of deep reading, thought and a clear orderly mind.

Apparatus for Industrial Laboratories

Meeting the Needs of the Consultant and Particular Industries

THE publication of catalogues describing apparatus meeting the needs of laboratories with a specialist bias in industry is a feature of the activities of A. Gallenkamp and Co., Ltd. Apparatus for micro and semi-micro analysis is described in detail in their list No. 103A (32 pages). The semi micro section of this catalogue is claimed to be the most up to date in the world. Realising the coming importance of the semi-micro type of apparatus they arranged for Dr. G. W. Ferguson, of the Chemistry Department, Birkbeck College, London, to undertake the translation of the original German text-book on this subject,* so that the technique of the methods would be accessible to English readers. The accompanying illustration shows the apparatus which is used for the determination of carbon and hydrogen by the semi-micro method of Bobranski and Sucharda.



Complete Combustion Train for Micro-determination of Carbon and Hydrogen.

Realising there was not available a complete sectional catalogue dealing with laboratory apparatus for the milling, baking, grain, seed and allied trades A. Gallenkamp and Co. published this List No. M.105 (88 pages) in the preparation of which they received valuable help from Dr. C. W. Herd on the milling and baking side, also some practical guidance from Mr. P. S. Jewell and Mr. J. P. Hallett, of the Swansea and West Wales Bakery School.

When it came to a matter of selecting rubber testing apparatus for experimental and research purposes, the rubber technologists were also in a quandary, so with valuable help received from the Research Association of British Rubber Manufacturers, List No. 104 (60 pages) has also been published.

Rubber ageing apparatus is described in List No. 104. The rubber ageing air bomb apparatus marks a big advance in the technique of rubber ageing and affords a new method and means for accelerating the ageing of rubber and rubber compounds in a much more rapid manner than by any other known test. Where the ageing of rubber compounds or stocks has hitherto been regarded as impracticable, owing to the excess length of time required for treatment they may now be subjected to the ageing test by the use of this air bomb. Stocks which are highly resistant and those designed to meet high temperature conditions may also be treated. This compressed air and heat test (air bomb) is by far the most drastic method of ageing rubber and few age resistant compounds can withstand more than about ten hours treatment.

* Semi-Micro Methods for the Elementary Analysis of Organic Compounds, by Bobranski and Sucharda. Authorised translation by G. W. Ferguson. Gallenkamp and Co., 6s.

Laboratory Methods in Fruit Products Research

By VERNON L. S. CHALEY, B.Sc.

THE laboratory work carried out in the Fruit Products Section of the University of Bristol Agricultural and Horticultural Research Station at Long Ashton, falls into two main classes. In the first place the research station is responsible for the advisory work in cider and fruit products for the whole of the British Isles under the Ministry of Agriculture's scheme, whilst many inquiries and problems involving analysis and on some occasions extensive study of liquid fruit products are constantly being received from the other parts of the Empire. The scope of this advisory work has been widened to a remarkable extent by the commercial exploitation last summer of the results of recent research work by the writer on the utilisation of surplus fruits by their conversion into a series of stable liquid products. Firms commencing the large scale production of pure fruit syrups were advised on all aspects of the processing, and when production actually began in June, 1936, the research station was overwhelmed with problems which often had to be dealt with at a moment's notice at all hours of the day and night to enable batches of fruit to be used to best advantage.

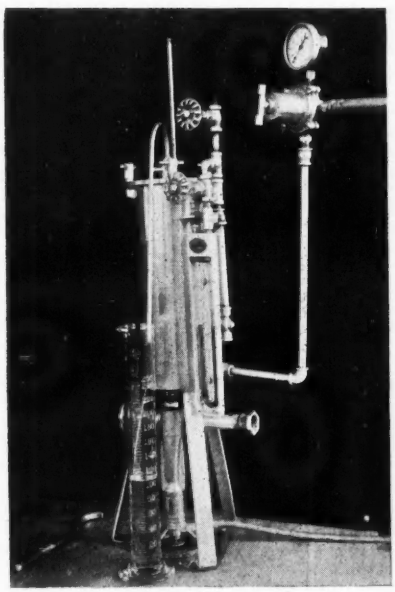


Fig. 1. Dicalite Filter Bomb (F. W. Berk and Co.)

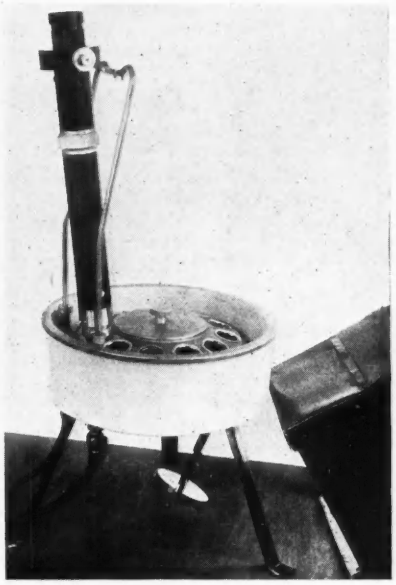


Fig. 2. Zeiss Industrial Refractometer.

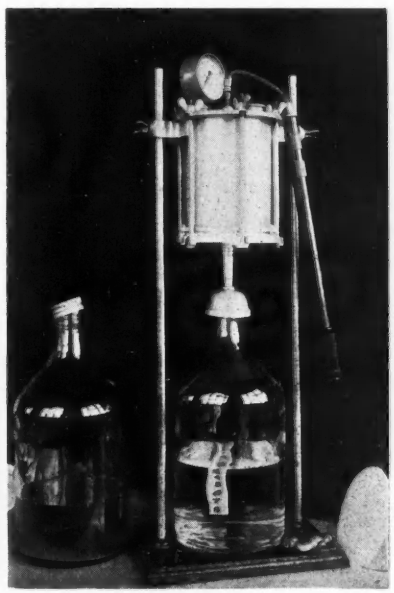


Fig. 3. Seitz Laboratory Filter.

Secondly, there are the research investigations, mainly of a biochemical nature, dealing with the chemistry of English fruits in general, and with those of the apple in particular. Research into such a wide and complicated field naturally makes use of no particular series of operations, and this article is consequently concerned with those determinations which are most frequently in use.

Cider Analysis

All ciders examined for any reason whatever are analysed for specific gravity (using an ordinary hydrometer), malic acid acidity (titration of cider freed from CO_2 with 6.7 soda) and "tannin." This last constituent is of great importance from an organoleptic point of view, as it confers astringency and "body" on the beverage. The method in use at Long Ashton is that of Löwenthal and involves the titration of the cider (1 cc. in 300 cc. water) with permanganate solution (0.0785 per cent.) using standardised indigo carmine as an internal indicator. Obviously this method will involve the estimation of other substances besides tannin (such as colouring materials), but the specific removal of these other compounds is extremely difficult, and it has been amply proved that the permanganate-reducing figure can be correlated with exactitude with the astringent taste of the cider.

Alcohol is determined by distilling off 80 cc. distillate from 100 cc. cider using an efficient cooling system. The cider is generally first neutralised and rendered just alkaline before distillation. The distillate is brought to correct temperature, bulked and the density determined with a specific gravity bottle. The alcohol content is obtained by reference to the appropriate tables.

Determination of Original Gravity

It is often necessary to determine what was the original gravity of a fermented cider, and the official method used by the Government chemist for beer has been found to be accurate for cider. The density of the distillate obtained in the alcohol determination is used to evaluate the "spirit indication." This value is converted into "degrees of gravity lost" by means of Jones and Baker's tables for beer. The "extract gravity" is next found by determining the gravity of the residue left in the distillation process, and the sum of "extract gravity" and "degrees of gravity lost" gives the original gravity of the cider with considerable accuracy.

Sugar determination has been prominent of late on account of the marketing of a series of "dry" ciders for rheumatic and diabetic patients. The sugar content of such beverages must be very low, and it is not satisfactory merely to use tables to convert specific gravity values to sugar percentages. The cider is cleared with lead acetate, excess of lead immediately removed with potassium oxalate and the reducing sugars determined by the Lane and Eynon method. An aliquot of the cleared solution is inverted with citric acid for 15 minutes by boiling under a reflux condenser. The inverted sugar solution is then neutralised and titrated with Felling's solution by the same method. Inversion of sucrose by natural means is usually complete after the first fortnight of fermentation in the fresh juice, and consequently fully fermented ciders do not generally contain any sucrose.

For nitrogen determinations the cider is evaporated to a thick syrupy consistency in vacuo in the Kjeldahl flask and then treated in the usual way for wet digestion with sulphuric

acid and subsequent distillation of ammonia. Nitrates are not usually present.

The presence of considerable amounts of volatile acidity in ciders is indicative of the access of air to the product, and betokens the use of inferior fruit or faulty and careless storage

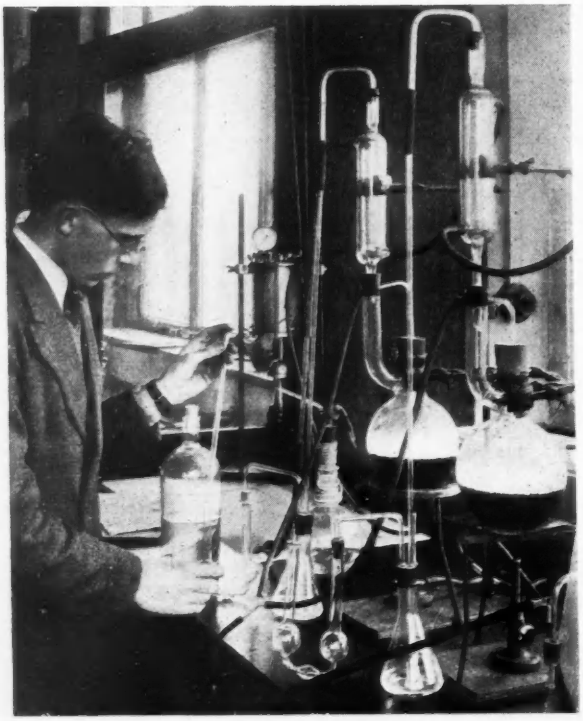


Fig. 4.—Determination of Sulphur dioxide by the Monier-Williams method.

conditions. The cider is distilled in a current of steam produced from thoroughly boiled out water and the distillate is titrated with soda, using phenol phthalein as indicator. Although acetic acid comprises the greater proportion of the volatile acidity, formic, caprylic and caproic acids are also found to a slight extent

In the determination of mineral matter the cider is reduced to a syrupy consistency in a water bath and thoroughly charred and leached with water to prevent loss of potash by volatilisation at the high temperatures needed to complete the ashing. The leachings are returned to the gold dish and evaporated, and gently dried over a low flame. On occasion a complete analysis of the ash constituents is carried out. A system for this detailed analysis has been worked out to cover most types of biological material.

Cider Investigations

It is often necessary to examine the ash of a cider for traces of metals such as lead, copper, tin, nickel, chromium and aluminium. Iron is always present to a greater or lesser degree and often causes difficulties in the determination of minute amounts of lead and copper. The latest colorimetric methods are used for the metallic determinations, but on some occasions the methods for separation of interfering metals have to be extended.

The examination of the yeast population of ciders is an important section of the routine and research work. It is often necessary to follow a commercial process from stage to stage by taking samples for plating-out on malt agar to discover the exact source of infection. Research work on the use of the supercentrifuge for checking fermentations that become too rapid entails the examination of large numbers of plate cultures. A further feature of the laboratory work is the preparation of completely sterile juices or ciders. This is effected by the Seitz laboratory filter, using a sterilising E.K. disc. This filter is of great use when pure yeast fermentations are being investigated; it is essential that the natural yeasts and other micro-organisms should be removed before the addition of the pure wine yeast culture. The Seitz E.K. disc can be used for all fruit juices, and offers a convenient means of preserving samples of these beverages without having recourse to heat.

Fruit Juices

All the determinations described above for cider products are in constant use for fruit juices in general, but two further operations are of considerable importance. In the Long Ashton cold process for the production of pure fruit syrups the pectinous materials are dispersed by a slight controlled fermentation aided by Filtragol, a pectin-decomposing enzyme. Extreme importance attaches to the determination of the progress of the removal of pectin, in order that the fruit pulp may be subjected to hydraulic pressure (to express the juice) immediately the pectin is almost completely removed.

Two methods are used to follow this enzyme reaction. The calcium pectate method of Carré and Haynes is accurate, but time-consuming, and quite useless for quick determinations such as are needed in these circumstances. It has been found that the progressive dispersal of the slimy pectin materials affects the viscosity of the juice and a routine method has now been adopted in which the Ostwald viscometer is used to the accompaniment of all the precautions of standard temperature,

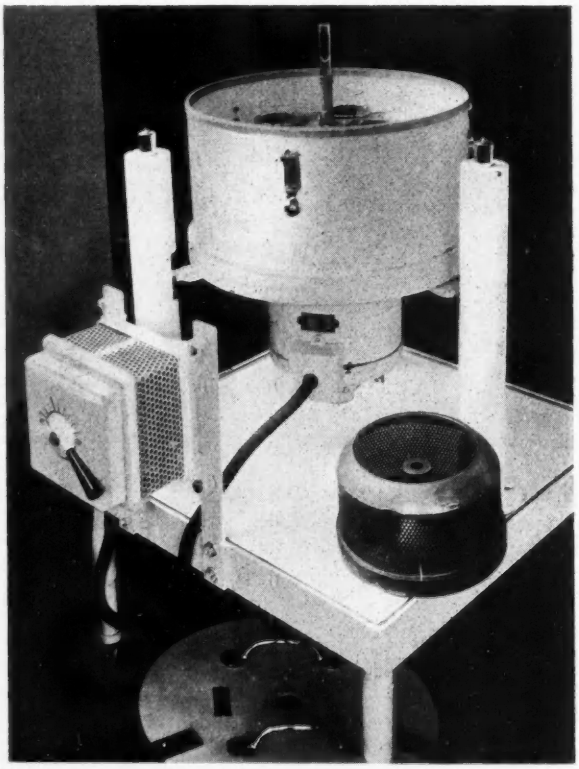


Fig. 5. Hearson's Centrifuge. The perforated basket is a fitment for the concentration of fruit juices by centrifugation of frozen juice.

etc., essential for obtaining reproducible results. With satisfactory enzyme action the value for the juice approaches very closely to that for water.

For ascorbic acid fruit juices can be titrated directly with Tillmann's indicator, 2 :6 dichloro-phenol-indophenol, provided that no preservatives or colouring matters have been added. The determination is carried out in acetic acid solution and offers no complications. Last summer the first series of experiments on fresh fruit juices from different varieties of

soft fruits were carried out at Long Ashton, and indicated that fresh black currant juice contained more than twice the amount of ascorbic acid usually present in lemon or orange juice, while the juice of strawberries equalled the citrus juices in content of this accessory food factor.

The total SO_2 in fruit syrups is determined by the usual Monier-Williams method. An adaptation of this method has been evolved to determine the " free " SO_2 in fruit syrups. The *p*H of the material before distillation is adjusted to 3.5 and the SO_2 distilled off (without the addition of acid) at 50° C. in a vacuum produced and maintained by an ordinary water pump. The determination of " free " SO_2 in syrups is of the utmost importance. The suppression of yeasts is effected solely by this form of SO_2 and fixation of SO_2 by sugar and aldehyde compounds occurs to varying extents in sugar syrups.

The largest outlet of the new pure fruit syrups, marketed under the National Mark of the Ministry of Agriculture, is the " milk bar " organisation and for this purpose the syrups must be carefully examined with reference to their incorporation in milk without causing any obvious precipitation of casein. Many thousands of milk shakes have been made at Long Ashton during the past eighteen months in collaboration with the Milk Marketing Board.

The respective filtering powers of various diatomaceous earths, and the results obtained by mixing proportions of different grades together, have involved, until quite recently, the treatment of fairly large bulks of juice or syrup. The Dicalite Co., of America, through their agents in London, F. W. Berk and Co., Ltd., have loaned a filter bomb to the Fruit Products Section, which is designed to obtain exact comparative data on the filtering performance of various grades of prepared filter aids with special reference to clarity and speed of filtration. The juice or syrup is mixed with the recommended proportion of powder and forced through a small filter cloth by air pressure. The rate of filtration is measured for each three minute period up to thirty minutes and the clarity examined. The apparatus has recently been used to obtain accurate information on the filtration of a wide variety of fruit products, including some of the thicker juices such as sloe and heavy fruit syrups with 45-58 per cent. sugar content and 60-75 per cent. of juice.

Research and advisory work on the actual preparation of jam does not come within the scope of the activities of the Fruit Products Section, but fruit pulps have been investigated on several occasions.

For the determination of soluble solids the Zeiss industrial refractometer is used. A 20 per cent. extract of jam is examined at a temperature of 20° C. and the soluble solids content is obtained from the appropriate tables. The figure for jam should be at least 68.5 per cent. The residue from the water extraction made for the determination of soluble solids is dried to constant weight to determine insoluble solids.

The lead salts of the acids present in the jam are obtained by precipitation with lead acetate. The separation of the precipitate is, however, a difficult matter and is most effectively achieved by high speed centrifugation, and a Hearson's bucket centrifuge has proved invaluable for this purpose. Four buckets of heavy metal act as containers for the 200 cc. centrifuge tubes and the material containing the lead salts is centrifuged for twenty minutes at 4,000 r.p.m. The acids are liberated by H_2S and the citric acid is then determined by its conversion into pentabromacetone by H_2SO_4 and KBr.

Ultra-Violet Radiation

Improved Equipment with Extended Uses

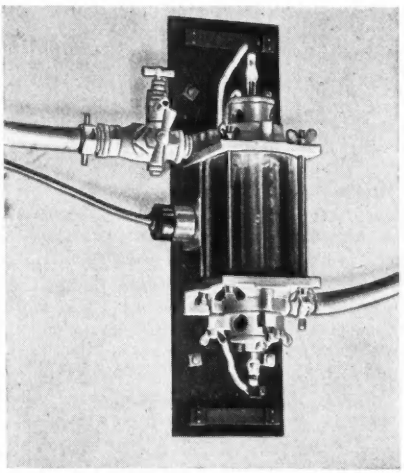
MANY of the complex reactions of modern chemistry cannot be effected without the aid of photo-chemical energy in the form of ultra-violet rays. Classical instances are the activation of sterols to form Vitamin D, the usage of ultra-violet rays as catalysts, the handening of oil films, and the " ageing " of rubber. Also of interest to the chemist are certain biological effects of these rays, *e.g.*, for the activation of yeast, the destruction of bacteria.

These extending uses for actinic radiation will ensure a welcome among chemists for the new forms of technical ultra-violet lamps recently introduced by Hanovia, Ltd. In the new lamps, high pressure mercury arcs operated in quartz tubes are still utilised to generate the actinic radiation, but the chemists will find these new arc tubes far more handy than their predecessors. The new high pressure mercury arc tubes are self-starting, operate in any position, and are unaffected by external temperature conditions. They are also much lighter, and less fragile, and since they take the form of simple tubes which can be made straight or curved as required, it is not difficult to build them into effective optical systems so that much greater economy can be obtained.

The development of these new tubes, under an extensive series of exclusive patents, has necessitated years of technical work. A whole series of new ultra-violet sources are now available, based on a series of five standard arc tubes (loading from 700 down to 150 watts), each of which has been calibrated in respect of ultra-violet output, measured in micro-watts per sq. cm. at standard distance.

The bactericidal vitamin-activating properties of ultra-violet rays are frequently utilised to advantage in irradiation of fluids, *i.e.*, water for drinking, brewing, butter-washing, etc. The " Uster " steriliser, which is illustrated, furnishes an equipment of unsurpassed efficiency and convenience for all such purposes. The arc tube (type S.700) is the most powerful ultra-violet source in the entire Hanovia range. Being made to operate on either A.C. or D.C., and in any position, it adapts itself for the purpose in a way which is not possible with earlier forms of quarts burners. As shown, the arc tube is mounted axially within an annular irradiation chamber 13 cm. long and 780 ccm. volume. Fluid is admitted from below so that the rate of flow can be varied as required.

In dairy tests, only 0.85 per cent. of bacteria (proteolytes)



The " Uster " Steriliser (Hanovia Ltd.)

survived irradiation at an hourly rate of 3200 litres flow; with a flow of 720 litres, only 0.35 per cent. survived. These figures illustrate the value of this method of sterilisation for any purpose where a high degree of purity is required. The equipment is fitted on a wall bracket. In use, a casing with observation window (not shown in illustration) covers all working parts.

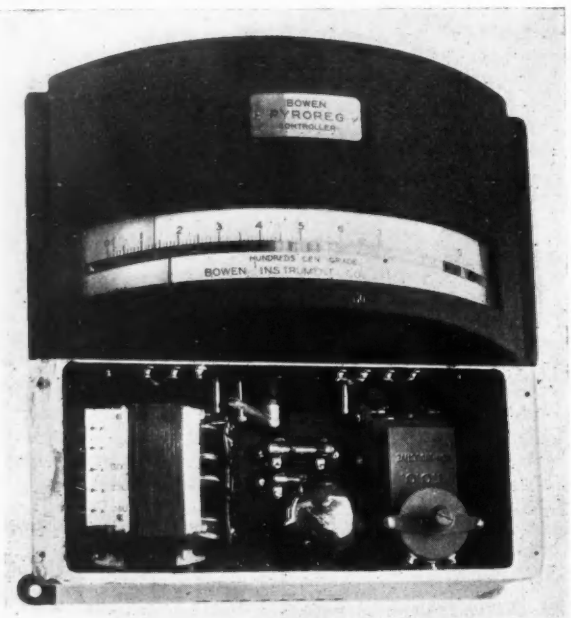
The Measurement of Temperature by Pyrometers

Some Exceptional Achievements

WITH practical experience extending over 27 years in the design, construction, application of general instruments, and in particuar of electrical pyrometers, it is not surprising that the various types of pyrometers made by the Bowen Instrument Co. have created records of performance in several directions.

Recorders supplied over 14 years ago are still in daily use without once having been repaired, and there is no known case of broken suspension in any instrument supplied by them. A special method of suspension is used, which avoids entirely the usual defects of moving systems; that is to say, there is no levelling, and no danger of broken suspension through shock or rough handling up to a considerable amount, also no " zero creep " (which is an insidious trouble not frequently mentioned, but a troublesome matter with ordinary suspensions.

A second feature of importance relates to their " Pyro "



The "Pyroreg" Temperature Controller (Bowen Instrument Co.)

radiation pyrometers. These handy instruments of portable form weigh only 19 oz., and yet give an accuracy of between 1 and 2 per cent. (which is as fine as can be guaranteed by Government testing laboratories for any radiation instrument). Moreover, they develop an e.m.f. of the order of 50 millivolts, which is far in excess of any other radiation pyrometer, and equal to thermocouples actually inserted in the same temperature source.

A third feature worthy of mention relates to their " Optix " optical pyrometer, which is used for measuring temperatures of molten steels, etc., as well as for ordinary furnace work. The actual scale of temperatures is more than twice as long as in any other pyrometer of optical type, and the point of comparison made by the observer can be checked so closely as to be equivalent to two or three degrees only, at ranges between 750 and 1,800° C. It is a real " unit " construction without loose cables or heavy batteries of any kind, it is self-checking, and new batteries can be obtained for 6d. at any local dealers.

The Bowen Instrument Co. have now added to these fine instruments of recognised merits a new automatic temperature controller called the " Pyroreg." The principle of control employed is that of illuminating or darkening a photo-electric cell according to the temperature reached in the furnace under control. The speed of response of a photocell is well known, used as it is to-day in a great number of ways such as to operate " talkie films," television, burglar alarms, automatic street lighting, etc., and one well-known firm states that " the instrument has been used over considerable periods and has not failed at any time during test, the sensitivity of control being somewhat greater than in any type of contact-operated controller with which they are familiar." At another large works, results of tests showed that the " Pyroreg " controller maintained the furnace temperature at 700° F. within ± 1° F., whereas the same furnace under identical conditions was maintained at 700° F. within ± 30° F. by means of a contact-operated controller of potentiometric type and of another make, well recognised and of first-class standing. In other words, the two instruments were " not in the same street," as the Pyroreg completely outshone the other. There is a further merit that the moving pointer is not interfered with or touched by any mechanism, but moves smoothly along the temperature scale just like an ordinary indicating instrument.

Fine Limits of Control

The accompanying illustration shows that the " Pyroreg " controller has an exceedingly long scale of 10 which is easily readable to within 1 or 2 degrees, and the slightest movement of the pointer around the " control mark " is sufficient to control the furnace heating off and on. In the case of controlling and " auxiliary " or by-pass heater, very fine limits of control can be effected in any furnace, large or small; the instrument can be calibrated to any temperature range desired. For example, a range of 200 degrees across the scale for use with resistance thermometers-as in cold storage, steam, chemical plants, and the like; again a range of 0-400° C., 600° C., 800° C., 1,000° C., or 1,200° C. for use with thermocouples, for general heating requirements in all kinds of works; and lastly, a range of 600-1,200° C., 700-1,400° C. for use with radiation tubes as in glass works, gas, steel, and other industries.

The Bowen Instrument Co. are also engaged in the design of a new temperature recorder. The existing recorder employs chart rolls lasting 30 days, and of width 70 mm, capable of recording three temperatures simultaneously on the same chart. In the new recorder a wider chart of 120 mm is used, driven by a synchronous motor of self-starting type, and with means for recording in different colours up to 6 records simultaneously. The instrument may be for wall mounting or for panel fixing. The same high sensitivity movement of the design mentioned above is employed, proved over so many years as the most efficient and satisfactory in practical usage.

THE Montecatini concern, in its report for the trading year 1936, reports a gross profit of 169 million lire (126 million previously) and a net profit of 84 million lire (against 67.5 million) out of which it is proposed to distribute a dividend of 10 per cent. (against 8.5 per cent.). The following points of interest are selected from the detailed account of the multifarious activities of the company and its subsidiaries: Rayon production of the " Rhodiaceta Italiana " fell off slightly from 4,030 tons to 1,390 tons. Special attention was given to development of the pharmaceutical and synthetic perfume departments with a view to reducing imports of these products (now amounting to 100 million lire per annum). Production of copper sulphate in Italy remained unchanged at about 125,000 tons, aluminium production rose from 15,000 to 15,000 tons, and sulphur production fell off slightly from 352,000 to 327,000 tons.

The Industrial Consultant and His Laboratory

By HARRY BARRON, Ph.C., B.Sc., A.I.C., A.I.R.I.

JUDGING from the favourable remarks invariably made at company meetings regarding the value of research, it would appear that it does pay. Tangible results are visible not only in cash for the shareholder, but in widespread improvements in the modern comforts of the consumer. Research benefits the community all round.

Consider the make-up of most chemical industries at the present time. There are a few mammoth concerns possessing large capital resources, and many smaller firms decreasing in size down to the one-man concern. The competitive ability of the lesser concerns depends almost entirely on keeping down overhead charges. Many of them are fully alive to the benefits which they could derive from development and research work, but the burden of overhead charges involved in maintaining such a department would be too heavy for them.

Apart from concerns directly engaged in an industry, consumers also find it necessary to check up on materials from the point of view of quality. It also happens that some materials are employed in a number of industries where their intrinsic properties cause difficulties. As examples of this, I can quote materials in which I am interested—rubber and plastics. Rubber in its various forms, and particularly as latex, finds its way into many outside industries. Since rubber firms with great experience of the materials often have difficulties with it, it is not surprising that these other industries meet trouble. The same applies to plastics, and no doubt to many other materials.

Sources of Information

Where, then, can information regarding these problems of control, development and research be obtained? Either from service departments of supplying firms, research associations, or from consultants specialising in the particular industry.

Service departments are very useful, but aim at selling their own products. Many industries have joint research organisations which can give such advice and are in a position to carry out tests and make reports. But such organisations are generally working on some specific programme of work intended to benefit the industry as a whole. Their revenue is not dependant upon returns for services rendered. Consequently there is only a small staff available to handle commercial problems, while plant is taken up on the major problems. As a result, commercial problems must take their turn and there is delay in obtaining results. But in industry when difficulties crop up, time is the great enemy. After all, if something goes wrong with production it has got to be put right quickly, or headaches are going to develop. The manufacturers must turn elsewhere to obtain immediate attention.

Technical problems frequently crop up involving the composition of materials and their use in products or processes. Changed sources of raw materials lead to products which are inferior in quality. Products misbehave without any alteration in the process of manufacture. Colours change without reason; emulsions or suspensions refuse to remain stable; these and a host of other inexplicable deviations occur at awkward moments. If not in a position to solve the problems, the manufacturer must get outside assistance without delay.

Personal Attributes of the Consultant

In almost every chemical industry there are to be found a few men who, having a wide knowledge of the industry, have set up small-scale plant and organisations for carrying out research work on the problems of that industry. These are the industrial consultants.

Every large concern employs a staff of chemists to look after production. In many cases there is a development department to introduce new ideas and products and to reduce existing costs. Take the chief chemist and the head of the development group and combine them into one person. Put him into his own laboratory, and you have the industrial consulting chemist.

What are his qualifications? He must evidently possess a sound knowledge of every phase of that particular industry. He must be acquainted with the processes which are carried out, and the machinery necessary for them. Raw materials and accessory materials necessarily feature as part of his knowledge, while his acquaintance with costings of finished products and the trends of the industry are valuable assets. In effect, he must be a veritable encyclopedia of that industry, who must know the sources from which information may be obtained. He should also know what sort of things are happening abroad. It is usually found that he is in close contact with the industry as a whole, and is associated with every progressive activity. Generally he has a commercial flair, an almost intuitive ability to spot a commercial proposition and a final personal attribute of this industrial Admirable Crichton is the ability to explain himself.

The Inarticulate Chemist

The inarticulate chemist is one of the most deplorable products of present day specialisation. Every industry has its own jargon. Since many of the consultant's clients come from outside the industry, he must avoid esoteric allusions and convey his meaning, if possible, in basic English.

As I have suggested, very large firms will have a staff possessing the knowledge that the consultant has, in addition to well-equipped laboratories and trained assistants. Evidently they do not require his services except as an independant authority in the case of disputes. But he can be very useful to the smaller firms which cannot afford to maintain an efficient research department. By using him, the small firm virtually adds a chemical department without incurring establishment charges.

Every progressive manufacturer is constantly looking for new products, in addition to improving his existing productions. In new developments consideration must be given to many factors. What materials will be most economical and satisfactory to use? What operations should be employed to produce the finished product, and what equipment is best adapted to this end? These are problems which in many cases the manufacturer may not be in a position to answer.

Another angle concerns the introduction of new products to the particular industry. In bringing forward any new product there is always an enormous inertia, a reluctance to change, which must be overcome. The case presented for the new materials must be a thorough and convincing one, otherwise it cannot possibly succeed. Of course, such products must be submitted to comprehensive tests relating to their use and effect. This work can only be carried out by one who is fully conversant with the industry. It is hopeless to expect the staff of any manufacturing concern to do the spade work for a new product. Liaison work of this kind is obviously within the scope of the industrial consultant.

The Consultant's Laboratory

So far I have discussed only the personal attributes and the scope of the industrial consultant. But what about his material equipment? I have already implied that he must possess his own laboratory. What is more, his laboratory should be sufficiently well-equipped to carry out the fundamental processes involved in that industry. To-day, few products are made which do not involve the use of machinery. In large works, testing and development work are generally carried out on small-scale plant. If the consultant aims to be comparable he must possess similar plant. The only alternative is that he should have access to such plant. This,

however, is, at the best, an unsatisfactory expedient, because of the necessity for secrecy, while his liberty of action and efficiency is impaired. Consequently, it is found that most consultants possess small scale plant on which they can carry out work in a manner comparable with that applying under works conditions. He is indeed a fortunate one whose work can be carried out entirely verbally or on paper.

From the chemical angle, the consultant's laboratory must be equipped to carry out the standard tests of the particular industry. With rubber, for example, he must be in a position to carry out tests on raw rubber, vulcanised rubber, reclaimed rubber, the various ingredients, and fabrics.

But this is not good enough if he wants to cover the production side of the industry. Well-equipped company laboratories include such plant as laboratory two-roll mixing mills, laboratory calender, a small extruding machine, a press and an autoclave to correspond with the apparatus used in the factory. In addition to this there is the apparatus for testing the physical properties of rubber products, *i.e.*, a Schopper or a Scott tensile testing machine, a thermostatically controlled ageing oven, oxygen bomb, plastometer, hardness tester, abrasion testing machine, and flexing machine. Equipment of this type does not change very frequently, although there is much controversy as to the value of results obtained with the different testing apparatus. An example of change in technique is in the ageing of rubber.

One of the best known methods for the ageing test is to use a thermostatically controlled oven known as a Geer oven, in which samples of vulcanised rubber are kept at 70° C. for several months. A closer duplication of natural conditions of deterioriation is obtained with the oxygen bomb, in which samples are heated at 70° C. in oxygen at 300 lb. pressure for periods varying up to several weeks. Quite recently the air pressure heat test has come into prominence as giving excellent results in the very short time of a few hours. Here, samples are suspended in an autoclave at a temperature of about 130° C. and submitted to compressed air at about 80 lb. per square inch. A change in the time of test from weeks to hours is a matter of some importance to industry.

On the other hand, when dealing with latex, heavy plant is not required. The average chemical laboratory is sufficiently well-equipped to handle the material. It is an advantage to possess a colloid mill or a ball mill for reducing filling materials to a fine state, but the presence of a cone mill for mixing covers most requirements. I do not want to create the impression that I believe that a well-equipped laboratory will necessarily solve a works problem. What I do suggest is that work in the laboratory should precede full scale factory trial. To try out a "hunch" on the factory scale is an expensive way of doing things.

In my industry there have been relatively few unattached experts. The outstanding personality in this country, Dr. Schidrowitz, has been responsible for several revolutionary ideas which have taken their place in rubber manufacture all over the world. His notable achievements have been the vulcanisation of latex in the liquid state, and the production of softened rubber, both activities which have saved the industry trouble, money and plant; a host of other ideas in everyday practice, testify to his influence on rubber manufacture. Another consultant, in the plastic industry, is Carleton Ellis, the world's record patent holder, with more than 700 to his credit.

The Laboratories of the Food Investigation Board

By ELIZABETH GLENNIE, B.Sc. (Low Temperature Research Station, Cambridge)

THE Low Temperature Research Station at Cambridge, erected in 1922, is unique in that it is the first laboratory to be built specially for the study of methods of food preservation. Here, at Torry Research Station, Aberdeen, at the Ditton Laboratory, near Maidstone, and at the Covent Garden Laboratory, London, the Department of Scientific and Industrial Research, with the advice of the Food Investigation Board, is investigating the properties and behaviour of foodstuffs and the scientific problems involved in their storage and transport, particularly at low temperatures.

The object of cold storage is to retard deteriorative chemical and physical changes which take place more quickly at higher temperatures, and to lessen or prevent the attack of foodstuffs by harmful micro-organisms and insects. Foodstuffs are complicated biological systems, which are very sensitive to changes in their environment and, in particular, to temperature. At the Food Investigation Laboratories the effect of cold on materials, both dead (*e.g.*, meat and fish) and living (*e.g.*, fruit and vegetables) is being studied, the range of temperature being from 77° to —31° F. Observations are made under known conditions of temperature, humidity, and composition of the storage atmosphere. Altogether there are thirty-four brine-cooled constant temperature rooms. There are also three auxiliary constant temperature rooms for work at higher temperatures where no cooling is required.

Research at the Low Temperature Station on animal products includes work on meat and meat products, bacon and hams, eggs and poultry. The chemistry of the constituent proteins, fats, and pigments of these products is being investigated, and also the attack and breakdown of the tissues by micro-organisms.

Research on the proteins consists in separating them in a pure state and studying their physico-chemical properties. Recently two new proteins, an albumin and a globulin, have been isolated, in addition to the established proteins myosia and myogen. The solubility relations of these proteins and the extent and rate of denaturation determines the appearance and texture of meat and also its keeping qualities. To obtain a clearer understanding of the structure and properties of the meat proteins, analyses are being made of their constituent amino acids. Work on fats includes a knowledge of the constituent fatty acids and the extent to which the fats are oxidised and broken down by enzymes under different conditions of storage.

The colour of meat is a factor of considerable commercial importance. Haemoglobin is responsible for the colour of freshly-killed meat, but during storage and distribution this is changed to methaemoglobin. The pink colour of bacon, on the other hand, is due to nitrosohaemoglobin, which is formed by the interaction of haemoglobin with nitrate derived from the saltpetre in the pickle. Investigation is being made of the mechanism of the reactions in which haemoglobin is changed to methaemoglobin and to nitrosohaemoglobin. In addition to work on the dead flesh, study is being made of the influence of different ante-mortem factors on the proportions of muscle and fat in the animal, particularly the pig, and keeping properties of the flesh after slaughter.

The work on animal products has led to definite advances in the handling of meat before and after slaughter, and during storage in the chilled and frozen conditions; it has also provided in gas storage a new method of preservation for meat, bacon, and eggs. It has been found that if the air in the storage atmosphere is enriched with certain amounts of carbon dioxide, the growth of harmful micro-organisms can be reduced and the storage period prolonged. The discovery of gas storage for the transport of meat has enabled Australia and New Zealand, debarred hitherto because of the distance, to compete with South America in the chilled beef trade with this country.

It is necessary that the preservation of fish should be

studied at a port, and this work is concentrated mainly at Torry Research Station, Aberdeen, with a view to the improvement of current commercial practice. A supply of fish and other marine material of known history is provided by the Station's own vessel, a drifter-trawler, the " City of Edinburgh." The vessel tows a ¾ size trawl, has a well-insulated " hygienic " metal-lined fish room, small refrigerating plant, oil extraction plant, and laboratory for chemical and bacteriological work at sea. The refrigerating plant at the station includes equipment for freezing fish slowly in air or rapidly in brine tanks. A specially-designed wind tunnel apparatus, in which the temperature, humidity, and rate of flow of air are controlled, is used for studies of the drying of fish. There are also three experimental smoke kilns for investigating factors which are concerned in the smoking of fish.

Transport of Fruit at Sea

The control of temperature, humidity, and composition of the atmosphere is a comparatively simple matter in the laboratory, but in a great store, such as the hold of a ship, the problem becomes more complex, especially as the fruit must be stacked as tightly as possible on account of the value of space in a commercial refrigerated chamber. A cargo of fruit generates heat, gives off moisture, consumes oxygen and produces carbon dioxide. The heat and moisture must be removed from the cargo by the refrigerating plant, and the gases by ventilation. At the Ditton Laboratory, special attention is given to problems connected with the transport of fruit at sea, and tests are carried out in an experimental ship's hold, which has a capacity of 140 tons.

The experimental equipment consists of an elaborate temperature measuring outfit which enables temperatures to be read at some 250 points; both thermocouples and registered thermometers are used. Multipoint readings of air velocity are obtained by hot wire anemometers. Remote reading vane anemometers are used also. There are also instruments of the usual type for measuring humidity, for gas analysis, for measuring flow of liquid in the cooling circuits, and the input of electrical energy to fan motor, etc. A resistance thermometer outfit is used for measuring temperature with an accuracy of 0.1° F. and intended primarily for use on board ship. Readings are made by balancing the bridge with a slide wire and the null-point galvanometer. Although rolling of the ship makes readings more difficult to obtain, it does not affect the accuracy, since the readings depend on the direction and not on the magnitude of deflection of the galvanometer.

Maintenance of Constant Conditions

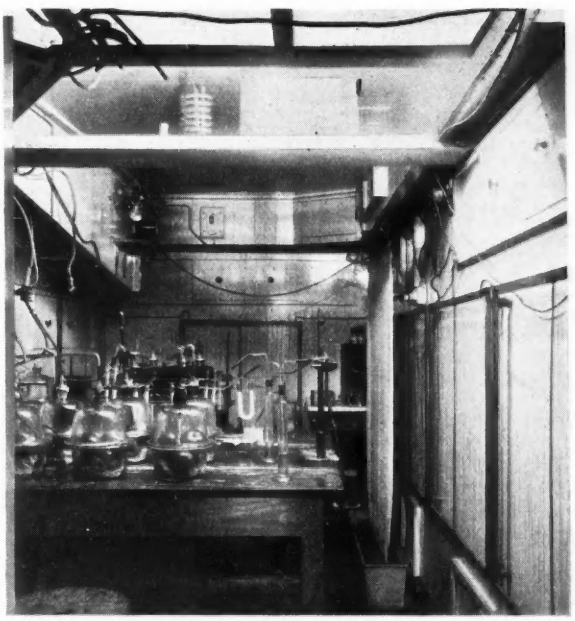
Since fruits and vegetables are living organisms, their preservation during handling, transport and storage depends on maintaining, within comparatively narrow limits, conditions under which physiological processes, such as uptake of oxygen and evolution of carbon dioxide, and chemical changes concerned in ripening can take place normally, but at a slower rate.

The chief condition which modifies the rate of ripening of fruits during storage is temperature. In investigations carried out at the Low Temperature Research Station, ripeness is judged by measuring the rate of respiration, *i.e.*, the rate at which fruit gives off carbon dioxide. The accompanying picture shows one of the cold-storage chambers and illustrates experiments in progress on the respiration of apples. The thermostat near the ceiling makes and breaks contact of the heating nets shown to the right of the picture, thus enabling a temperature to be controlled accurately. Tolerance of cold has been found to vary in different fruits, and even in different varieties of the same fruit. It is necessary, therefore, to find the optimum temperature for storing each type of fruit and to ensure that this temperature is kept constant throughout the storage period.

It has been shown that the rate of respiration of fruit can be decreased by reducing the supply of oxygen in the storage atmosphere, or by reducing the supply of carbon dioxide, or by a combination of both, and these principles have been used to develop a successful method for storing certain varieties of apples; it is known as " refrigerated gas storage." The outstanding advantage of this method is that ripening at any temperature is slowed to about half the rate in air at the same temperature, so that the " life " of the fruit in store is correspondingly twice as long, without affecting adversely the colour, firmness, or flavour of the fruit.

An Important Development

This prolongation of the life of the fruit is an important development in the storage of English apples, and growers have not been slow to take advantage of it. Experiment has shown that different varieties of apples differ in their tolerance of abnormal atmospheres, and it has been necessary to determine the most suitable atmosphere for each variety by carefully controlled trials. Care must be taken that certain limits of concentration of gases are not exceeded or storage disorders in the fruit result.



Interior of one of the cold storage chambers showing experiments in progress on the respiration of apples.

Although the chief products of respiration of fruits are carbon dioxide and water, studies have shown that there are also other emanations, some of which are in minute quantities and have remarkable properties. Among these is ethylene, the use of which in the artificial ripening of citrus fruits is well-known. It has been found that the traces of ethylene given off by ripe apples retard the sprouting of potatoes and of peas and other seedlings, but accelerate the ripening of young apples, bananas, tomatoes, etc.

Covent Garden Laboratory

In connection with work at the Low Temperature Research Station on the carrying qualities of fruit, a laboratory has been established at Covent Garden Market, London, as an observation point where examinations are made of overseas and home produce passing to the market.

At the Low Temperature Research Station, problems concerned in the canning of foods are also being studied. There is a small canning factory which includes, on a small scale, all apparatus required to carry out the complete process of boiling, blanching, steaming, canning, cooling, autoclaving, sealing, etc. In the laboratory studies also are made of the corrosion of metal cans by food products, particularly fruits, contained in them.

Modern Laboratory Distillation Methods

New Apparatus for Analytical Work

THE modern method of estimating small amounts of moisture in drugs, rayon yarns, cocoa, yeast, milk powders and the like is by distillation with appropriate entraining liquids such as heptane or carbon tetrachloride, the object being to eliminate some of the difficulties associated with older methods. Simple distillation, however, is extravagant, in time and solvent, and special apparatus has been devised by Griffin and Tatlock, Ltd., whereby the extracted water collects in a graduated tube and the entraining liquid siphons back into the distilling flask. The method may be applied to the estimation of the essential oil in drugs. As an indication of its accuracy, in a form developed in the Government Laboratory, repetitive determinations with a precision of 99.5 per cent. on as small a volume as 2 cc. of collected water are practicable.

An improved form of distillation apparatus for the determination of moisture particularly in materials of vegetable origin is shown in Fig 1.

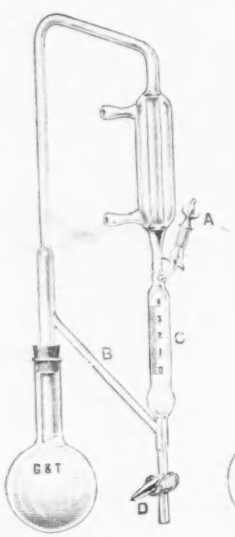


Fig. 1.

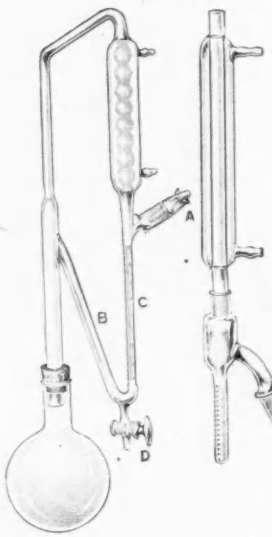


Fig. 2.

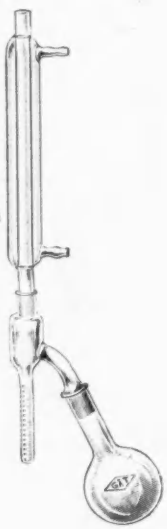


Fig. 3.

The water content of "air-dry" drugs is relatively high, and satisfactory results are not always obtained by chemical methods of determination or by simple drying. Modern practice, therefore, favours distillation methods based on the fact that, when a moist solid is distilled in a liquid with which water is immiscible, the distillate contains the water, which separates as an aqueous layer whose volume is a direct and objective measure of the moisture in the solid. In the case of vegetable materials the extraction of water from the cells proceeds slowly, so that simple distillation requires considerable time and needs a large amount of solvent. These difficulties have been overcome in the present apparatus whereby, during the distillation process, the water in the condensate is separated from the extracting liquid which then automatically returns to the distilling flask.

Solvent Extraction

The sample and about 50 cc. of an appropriate extraction liquid (tetrachlorethylene B.P. 121° C. or carbon tetrachloride B.P. 77° C. are usually suitable and are non-inflammable) are introduced into the 100 ml. flask. The siphon tube B. (Fig. 1) and the graduated tube are filled with the solvent from a pipette via the ground-in stopper A, which is only loosely inserted to provide an air vent, a slip of paper being inserted between the stopper and its seating; a rubber band is also hooked round the glass horns. The contents of the flask are then heated and as distillation proceeds an aqueous layer separates and collects in the graduated tube and the excess of (denser) extraction liquid is returned to the flask by the tube B Estimation is usually complete in 15-20 minutes, after which the volume of the collected water is read. It may be necessary to remove a little of the solvent through the draining cock D in order to bring the water meniscus to a convenient point on the scale. The apparatus, as illustrated (Fig. 1), has an overall length of about 16 in. The graduated tube reads to 4 cc. in. 0.1 cc.

Essential Oil Determinations

An improved form of distillation apparatus for the estimation of essential oil in drugs is shown in Fig. 2. Solvent extraction methods, as usually practised, of estimating the essential oil content of drugs are liable to errors, particularly those due to the difficulties of complete removal of solvent from the extracted oil and, in other cases, to solubility in water.

In use a 1-litre flask is connected to a tube delivering into a large-surface condenser to the outlet of which a graduated tube C is attached. The lower end of this tube is provided with a drainage tap D and with a siphon tube B leading back to the delivery tube. The overall length of the apparatus is about 24 in. About 300 cc. of water is placed in the flask and heated nearly to boiling. A weighed quantity of the substance in a suitable state of sub-division is introduced into the flask, the siphon tube is filled with water, the stopper A with a slip of paper beneath is inserted and a rubber band hooked round the glass horns. The distillation is then allowed to proceed at such a rate that the lower part of the condenser remains cool. The contents of the flask are occasionally swirled. The distillation is usually complete in from 2-5 hours, at the end of which period the volume of collected oil is measured. If the oil should display a tendency to stick to the sides of the tube, or if coherence of the droplets should be difficult to effect, a levelling bulb, containing dilute ammonia, may be connected to the drainage cock and the oil slowly raised and then lowered in the graduated tube.

Developed in Government Laboratory

The attention which has recently been given to the distillation method of moisture determination is indicative of its value. In the entrainment distillation apparatus as developed in the Government laboratory (Fig. 3) ground-glass joints are employed throughout and particular care has been exercised in the consideration of each part to ensure adequate drainage and resultant improvement of accuracy. Repetitive determinations with a precision of 99.5 per cent. on as small a volume as 2 cc. of collected water are practicable.

This apparatus is constructed throughout of Pyrex glass, which has excellent drainage properties, and is fitted with interchangeable ground-glass joints. The flask is about 250 cc. capacity and the graduated tube, in which the water collects, is divided into 0.02 cc. to a total of 2 cc. A quantity of the sample, yielding nearly 2 cc. of water, is placed in the flask of the cleansed apparatus, if necessary on a layer of dried sand to prevent caking and with a few silica beads to prevent bumping. It is then covered with the distillation liquid, for which a paraffin, such as commercial heptane, having a boiling point 99-100° C., has been determined to be very suitable. The apparatus is assembled and sufficient heptane poured down the condenser to fill the graduated portion of the receiver. Distillation is then commenced, heating being by means of an electrically heated air oven or an oil bath. Gentle distillation should be continued for the length of time which a trial test shows to be adequate. The water collects in the graduated tube and, at the conclusion of the operation, droplets adhering to the condenser walls may be washed down by a spray of the entrainment liquid.

The Laboratories of the Tottenham and District Gas Co.

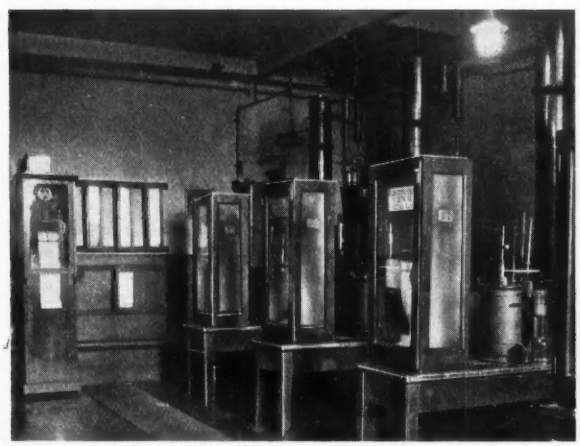
Coal Sampling and Gas Analysis

THE main laboratories of the Tottenham and District Gas Co., situated at the Willoughby Lane station of the company, control the manufacture at that station, and also watch over the purchases of general stores. These laboratories comprise a central analytical laboratory with gas analysis room and office above; a plant laboratory on the by-products works nearby; a calorimeter room from which all the gas making sections are controlled; a coal testing and research laboratory; a coke laboratory with domestic boiler and two domestic grates for practical tests and finally a small gas testing room adjacent to the locked official testing station. In addition, there are a sample room and sampling points in the retort houses with coal crushing and grinding equipment.

The staff are divided into two main groups, process chemists, who are each responsible for the efficient working of a section of the plant, and indoor chemists, whose work is mainly analytical. There is no hard and fast distinction between the groups, and it has always been the policy to operate a rota of duties in order to avoid stagnation and to provide completely trained personnel.

Coal Ash and Moisture

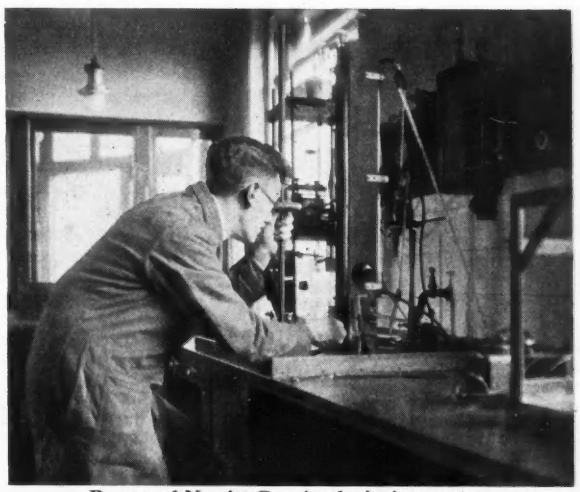
The three most important materials to be sampled in a gasworks are coal (on the constant quality of which the whole process of manufacture depends) and the two principal products, gas and coke. There are a number of other by-products, all of which have to be sampled and analysed, in addition to the usual store materials, the quality of which must be periodically checked. The coal used is mined in the gas coal areas of Durham and South Yorkshire, and in order to ensure continuity of supplies and uniformity of quality, it is necessary to draw from a number of collieries in each area. Most of the coal is bought on a standard ash and moisture basis so that it is necessary to sample every truck load which enters the works.



A battery of Fairweather Recording Calorimeters, Simmance Recording Gravitometer (extreme left), and Arkon Oxygen Recorder on wall behind calorimeter.

Samples of coal for the determination of ash are taken from the chutes feeding the coal, after crushing, to the retort house bunkers. The day's sample of coal from each colliery is collected in a separate bin, and after coal elevating is finished for the day, each sample is crushed and quartered in a Sturtevant power driven sampler-crusher. Each retort house has its own sampling point and Sturtevant crusher. The reduced samples are air-dried on a warm iron plate and ground to 60 mesh before delivery to the laboratory in the afternoon. The crushing and grinding of the samples in a hot retort house necessarily causes loss of moisture so that separate samples must be taken for moisture determinations. A large number of snap samples are taken as the trucks are tipped into the crusher hopper, and these samples are taken at once to the laboratory for test. Since the coal is uncrushed in these samples, the test is made on about 5 lb. in copper dishes.

In addition to routine determinations of moisture, ash, volatile matter and occasionally sulphur, samples of each coal are regularly tested in a Gray King high temperature carbonisation assay apparatus as developed by the Fuel Research Board. All new coals submitted for purchase are also



Bone and Newitt Gas Analysis Apparatus.

subjected to this assay, and a considerable amount of research on carbonisation is carried out with the apparatus. The results obtained are valuable, not only because the thermal gas yields correspond closely with full scale results, but also because they enable differences in yields due to varying moisture and ash contents to be differentiated from differences due to alterations in the composition of the actual coal substance. In addition, the apparatus often assists the decision as to whether inexplicable changes in large scale results are due to alterations in the coal or to changes in carbonising conditions in the retort houses, and in this way assists materially in the control of manufacture.

Coal Screening and Washing Tests

Much information about any particular coal can be obtained from screening and washing tests carried out at regular intervals. For screening tests a portable jigging screen driven by a 3 b.h.p. electric motor is used. This has easily removable screen grids and is mounted on a wheeled chassis. By its use, three men can screen a ten ton sample of coal into four sizes in about four hours. Screen analyses made in this way determine whether a run of mine coal contains an unusual proportion of fines or has had a particular size removed from it, whether a coal mixture varies greatly in composition, or whether a screened coal contains more or less fines than is known to be the normal result of breakage. The determination of the ash content of the fine material from a screened coal may also show whether the presence of fines is due to breakage or to bad screening.

Washing tests are used to determine the tendancy of a coal to produce "bats" in the coke. A bulk sample of the coal taken at the retort house is quartered down to about 2 cwt. This sample is tested for moisture, weighed and divided by standard hand screens into fractions over $\frac{3}{8}$ inch, $\frac{3}{8}$-$\frac{1}{8}$ inch, and dust below $\frac{1}{8}$ inch. These fractions are again weighed and the two larger washed by flotation in potassium carbon-

ate solution of specific gravity 1.4. The five fractions thus obtained, two "floaters," two "sinkers" and the dust are air-dried, weighed and tested for ash and moisture. The results give a very good idea of the distribution of dirt in the coal and, in the case of a washed or screened coal, of the origin of the fines. It is found that the proportion of material which sinks in pearlash of specific gravity 1.4, bears a very close relation to the number of complaints which are likely to be received from domestic users of coke.

The weekly averages of ash content of all coals are plotted on graphs and extra washing tests are at once carried out whenever the ash curve of any coal tends to rise. In this way obnoxious coals have gradually been weeded out and suppliers of coals under existing contracts are kept informed of results and their attention is drawn to deviations from the normal quality.

Coke Yields from Different Coals

In recent years the domestic market for coke has become increasingly important, and a close watch is therefore kept upon the coke yields from the various sections of plant and from the different coals. The various sizes of coke from each retort house are regularly sampled and tested in the same manner as the coal. In addition practical burning tests are performed on the appropriate sizes in a small domestic hot water boiler and in coke-burning grates. The physical nature of the ash from these appliances and the occurrence of "bats" are an essential part of the practical test which cannot be duplicated by any purely laboratory procedure.

The whole of the tar produced in the works is sold to a distiller, so that it is only necessary to sample each tank or barge before it leaves the works, and to determine specific gravity and water content of the samples.

Ammonium sulphate is manufactured in the company's by-product works and the process involves the daily testing of samples of ammonia liquor, sulphuric acid, effluent liquors and finished salt. Every consignment of ammonium sulphate despatched is separately sampled and analysed; deliveries of lime are also periodically checked. The ammonia washing process requires continual determinations of ammonia slip past the washers and of strengths of ammoniacal liquors produced.

Tests for Oxide Purification Process

The oxide purification process demands a considerable amount of work. Analyses are made of purchases of new oxide and the determinations of moisture, sulphur and tar in partly spent and spent oxides are carried out. In addition, sulphuretted hydrogen estimations are made twice daily on the gas at the inlet of each of the thirty oxide purifiers. Tutweiler's method or rapid lead paper tests being used, according to the sulphuretted hydrogen content of the gas. These tests and the necessary readings of temperature, pressure and rates of flow of gas and of air for revivification occupy the full time of a junior assistant.

The gas drying process involves comparatively little work, except to determine whether the trace of ammonia which passes the oxide purifiers and forms ammonium chloride has reached sufficient concentration for corrosion to become dangerous. In addition, check determinations of calcium chloride in the wash liquor are made for purposes of stocktaking, and when results indicate that the chloride concentration is deficient. Determinations of the dew point of the gas are made on the town's gas every time a holder is changed.

Benzole washing and refining, on the other hand, call for innumerable distillations of benzolised wash oil, stripped wash oil, crude naphtha, crude benzole and finished products. Benzole determinations on the gas at the inlet and outlet of the washers are not done as a regular routine, since recording calorimeters running on the gas from these two points give more valuable results, but occasional determinations of benzole vapour by freezing with dry-ice or by absorption in active carbon are an important aid to plant efficiency tests.

Gas analysis forms a very important part of the work of the laboratory. On the plant, continuous analyses of flue gases form a normal part of the routine of retort house control, and, together with daily pyrometer observations of each combustion chamber, ensure the economical maintenance of the desired temperatures. Twenty-four hour samples of the gases made in each of the three sections of plant, as well as a similar sample of the gas sent out to consumers, are collected in gas holders of fifty cubic feet capacity. A routine complete analysis is performed on each sample and the specific gravity and total sulphur content is also determined. Routine gas analyses are performed upon an apparatus largely devised in these laboratories, while plant control determinations are made with a portable Orsat apparatus. The extremely accurate analyses required for the coal assay are carried out with a modified Bone and Newitt apparatus. Complete gas analysis is important since the mode of combustion of the gas depends upon its composition and a knowledge of the gases which must be mixed to form the town's gas, enables some measure of control to be effected. The matter of combustion stability is regularly tested in these laboratories by a modified Ott burner developed here.

Calorific Values

Gas is now sold to the public on a thermal basis and each statutory gas undertaking has to declare the calorific value at which its gas is to be supplied. Independent examiners are appointed by the local authorities to make regular tests to ensure that the calorific value is maintained and that no trace of sulphuretted hydrogen exists in the gas. It is necessary, therefore, that the works laboratory should have complete and continuous knowledge of the calorific value of all the gases from the various sections of plant. To this end there is provided a calorimeter room in which a battery of five Fairweather recording calorimeters give continuous records of the calorific value of the gases from the three sections of manufacturing plant, and the mixed gases entering and leaving the benzole washers.

A further instrument in the official testing station on the works continuously records the quality of the gas sent out. This in under the control of the official gas examiner and the company's staff do not normally have access to it, but the record is visible to observers outside the room. Standard hand-operated calorimeter sets are provided in each testing place as stand-by instruments and for checking purposes. In the calorimeter room a continuous record is made also of the specific gravity of the town's gas by means of a Simmance recording gravitometer. An Arkon oxygen recorder is also provided; this may be used on any one of the gas streams in order to obtain a continuous record of its oxygen for purposes of oxide purifier control.

Testing of General Stores

In addition to the work outlined above, the analytical section of the laboratories deals with certain general stores. Paint, cement, refractories and other materials are tested as occasion arises.

The smaller manufacturing stations of the Tottenham undertaking have each their own laboratory and the staff of the main laboratory at Tottenham is available for such assistance as may be required from time to time. An entirely separate laboratory unit is attached to the distribution department of the company, and this is concerned mainly with the testing of appliances. Such problems of a chemical nature as arise in the company's dealings with consumers are generally dealt with in collaboration with the Tottenham works laboratory staff.

THE tin production at the Arnheim refinery of the Billiton Maatschappij will be increased as a result of impending extensions which will increase the annual capacity from 45,000 tons to 60,000 tons of ore. Measures are simultaneously being taken to triple the output of the company's tungsten factory.

Refractometers: A Choice of Instruments

By L. BELLINGHAM

WITH the exception of the microscope, no optical instrument is so deservedly popular, or has wider application in industry, than the refractometer. Instruments are now available ranging from the pocket refractometer weighing only 112 grams, and with an overall length of 16 cm., yet capable of an accuracy of 1½ units in the fourth decimal place, to the high accuracy critical angle refractometer, used for determining the constants of optical glass, and for other purposes where a high order of accuracy over a wide range of refractive indices is required.

Fig. 1.

In design, the pocket refractometer (Fig. 1), closely follows that of the larger instruments. Two glass prisms, between which is placed a drop of the liquid to be tested, are mounted in a hinged box. On directing the instrument towards the light, the edge of the dark shadow formed by the well-known critical angle is read by an orthodox optical system upon a scale divided from 0-25 per cent. soluble solids of sugar solutions. By estimation, readings can be taken to one-tenth of a scale division without difficulty, corresponding to a change of concentration in a sugar solution of 0.1 per cent. By using prisms of slightly denser optical glass, the pocket refractometer can be made to deal with sugar solutions of higher concentration, and one is supplied with a range from 61-78 per cent. soluble solids, for testing jams, syrups, etc.

This conveniently portable instrument is largely used in the cane sugar plantations, for sampling the cane for ripeness, on the spot, thus saving the time and labour which would otherwise be required in bringing samples to a central testing station. The pocket refractometer is also used for testing fruit juice, beer, cider, milk, waste water, and many other materials within its scope.

Where a wider range of products are to be dealt with, the standard refractometer (Fig. 2) is used. This instrument needs refractive indices from 1.3 to 1.7 directly to the third decimal place, and by estimation to the fourth decimal place, with an average accuracy of two units in the fourth place. The partial dispersion C-F of the material under examination can be obtained by referring the readings of the dispersion circle (situated below the telescope) to tables supplied with the instrument.

Fig. 2.

The standard refractometer can be used for testing any reasonably transparent liquid, solid, or plastic material, and it should be noted that in the design shown above, solids and plastic materials can be tested without reversal of the instrument since the lower prism box can be removed, thus allowing unrestricted use of the mirror for illumination of the sample. It is used for many purposes among which may be mentioned essential and mineral oils, fats, waxes, glass, crystals, glycerine, and other products whose widely differing natures render chemical analysis difficult and expensive.

A specialised refractometer has been developed for the confectionery trade, where close control is essential. The sugar refractometer shown in Fig. 3 not only shows the soluble solids from 50-81 per cent. upon a very open scale, but gives in addition the standard readings for butters, oils, fats, etc. A compensating prism enables a sharp, colourless border line to be obtained with white light. For sugar solutions, the temperature correction drum—a unique fitting — applies the necessary correction for any ordinary temperature without reference to tables. This fitting saves considerable time, and obviates risk of error due to the operator applying the correction incorrectly.

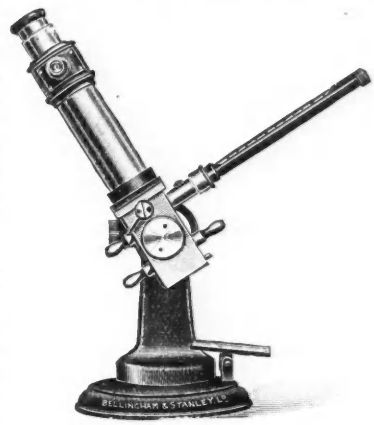


Fig. 3.

In determining the alcohol content of beers and wines where an even higher degree of accuracy over a smaller range is required, the immersion refractometer is usually chosen. When fitted with the normal prism, refractive indices from 1.325 to 1.367 can be measured upon an ocular scale to which a micrometer scale with drum is attached. Each drum division represents one-tenth of a scale division, so that refractive indices can be measured to 0.00004. Additional prisms covering other ranges are obtainable, and the instrument is so constructed that the prisms may be readily changed.

Fig. 4.

Observations with the refractometer at constant temperature are essential if the accuracy of the instrument is to be used to advantage, and this is secured by the use of the convenient tank (Fig. 4) to which the immersion refractometer is fitted. This tank will hold ten glass beakers in water at known temperature, and an indexing device permits each beaker in turn to be brought under the prism of the refractometer. Various fittings can be obtained, such as continuous flow cells for sugar work, or the instrument can be fitted to existing plant, as in the production of synthetic ammonia.

Recent research has produced an entirely new type of refractometer for industrial purposes. This projection refractometer (Fig. 5) merely requires that the material to be tested shall be applied to the prism surface 1, when the dividing line or edge is at once visible upon a scale 2, so large that no magnification is necessary. Thus the refractive index, as well as the soluble solids of sugar solutions, are instantly available. The flat, flush fitting prism surface is easily sponged over and dried ready for the next sample. The instrument reads from 30 per cent. to 90 per cent. soluble solids, over a scale 12.5 cms. in length. With a good dividing line estimations to 0.1 per cent. can readily be made. The adjacent refractive index scale is divided from 1.380-1.450 to 0.002, and thence to 1.517 to 0.001.

An outstanding feature of the projection refractometer is its ability to deal with dark coloured or even opaque materials. Black treacle, malt extract, tomato sauce, lemon curd, and similar difficult materials, such as jams, complete with skins and seeds, present no difficulty, since light is not required to

Fig. 5.

traverse the sample. The dividing line is produced by light reflected at the interface of the prism and the sample. Illumination is supplied by a small electric lamp contained within the instrument. This lamp, which takes 0.3 amperes at 4 volts, is readily accessible, and two spares are provided. The low voltage avoids risk to the operator in any circumstance.

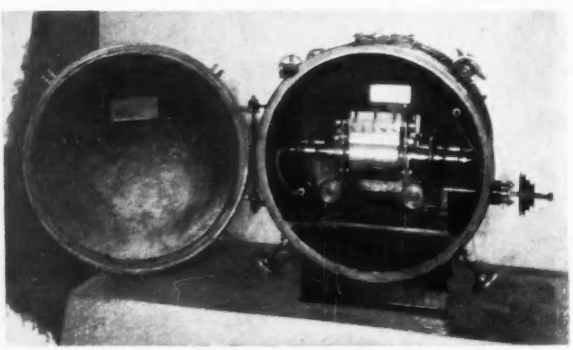
The accompanying illustrations show instruments which are supplied by Bellingham and Stanley, Ltd.

A Film Dryer for Experimental Use

Conducting Small Scale Tests in Secrecy

THE laboratory film dryer here illustrated is a development of a dryer which has been found useful in many laboratories. The normal dryer of the type is not designed for vacuum dryer, and the type illustrated has been produced by enclosing the dryer in a cylindrical case with a large hinged door at each end to give free access to the interior, for adjustments and removal of tray.

The roll sizes are 6½ in. diameter by 6 in. long, with a total area of 1.7 sq. ft., of which about 1.2 sq. ft. can be considered as effective in heating the liquid or solution to be evaporated. With the normal arrangement of 2-3 speed cord pulleys, 6 speeds can be obtained, ranging from 0.63 to 3.5 r.p.m. and if required 9 speeds can be provided. A ¼ h.p. motor at 1,400 r.p.m. is suitable for working up ordinary watery solutions, but for some materials which give tacky films more power may be required, and it is desirable to state the proposed uses when ordering such a dryer. The machines are arranged for working steam pressures up to 60 lb. per sq. in., and an evaporation of about 5 lb. of water per hour can be expected. The doors and the casing are well provided with windows for observation, and the steam and drain connections to the rolls are so arranged that the distance between the roll centres can be adjusted without disturbing these. The drive to the rolls is by means of worms and worm wheels, the worms being placed on a shaft carried out through a stuffing box.



Laboratory Film Dryer with Vacuum Casing.
(L. A. Mitchell, Ltd.)

Connections are provided on the casing for a vacuum gauge, vacuum suction pipe, steam and drain connections, air release, and liquor feed pipe. The liquor feed tank can be placed on a shelf above the level of the casing, and if considered necessary, this can be a closed vessel, with a vacuum connection above the liquor level, as well as the feed pipe from the bottom to the space between the rolls. The vessel for receiving the dried product is usually an aluminium tray below the rolls, but if required the rolls and the tray can be made of stainless steel or other metal. An electric lamp can be placed over the inspection window on the casing, and observation can then be easily made through the windows in the doors. It will be obvious that the machine can also be used for flaking suitable solutions by the circulation of cold water through the rolls.

These machines are proving of great interest to many works for research and works laboratories as they enable tests and small scale manufacturing to be carried out in privacy and secrecy. The makers are L. A. Mitchell, Ltd.

FIFTEEN varieties of "Postlip" filter papers are described in a new price list issued by Evans, Adlard and Co., Ltd. These papers are of British manufacture and are unsurpassed for quality. They are stocked in sheets, circles, folded circles and rolls, the circles ranging from 2¼ in. to 22 in. diameter.

SINCE moving into larger premises Coley Thermometers, Ltd., have considerably increased the various temperature ranges of their thermometers, and are now in a position to supply thermometers for practically every chemical need. Furthermore, they are now manufacturing pressure gauges in all sizes and have installed new test apparatus, thereby ensuring greater accuracy for their pressure gauges and thermometers. The improved methods of production made possible by their new premises have also enabled them to expedite deliveries considerably.

Precious Metals in the Laboratory

By F. BRABY

IT would be difficult to find any modern laboratory which does not use the precious metals in one form or another. Their resistance to chemical attack and high temperatures, their durability and high scrap value, makes their installation not only essential in many instances, but an economic acquisition as well.

Of all precious metals platinum is the most widely used in the laboratory. That it is economical in use is well shown by the example of the platinum parting apparatus installed in 1865 at the Assay Office and still in constant use. Platinum itself is a comparatively soft metal and some loss by volatilisation occurs when it is heated for any length of time at temperatures above about 1,300° C. The hardness and mechanical strength are greatly improved by the addition of up to 0.75 per cent. iridium, or 2 to 3 per cent. rhodium, and these alloys are those generally used for laboratory apparatus. Volatilisation losses are considerably lessened by the addition of rhodium to the platinum, while iridium tends to increase these losses. The rhodium alloys, however, are more susceptible to fusion stains than the iridium.

Platinum Alloys

An alloy of gold with 5 per cent. platinum is harder than platinum and resists chemical attack almost as well; it can be used for crucibles and dishes which are not to be heated above about 950° C. The crucibles can be used for bifluoride treatments, potassium bisulphate fusions and fusions with potassium sodium carbonate as well as for ignitions at less than 950° C. The alloy is somewhat less expensive than rhodium-platinum or iridium-platinum alloy and, within its more limited field, is just as satisfactory. An alloy of gold with 25 per cent. palladium (" Palau ") is used fairly extensively, and is in many ways a good substitute for the more expensive alloys, although the general corrosion resistance and mechanical strength is not so great. It cannot be used for potassium bisulphate fusions and it oxidises slightly on heating at 700° to 900° C., but it is much cheaper than platinum, due partly to lower specific gravity.

The most common piece of precious metal apparatus in the laboratory is the crucible, usually constructed of iridium-platinum or rhodium-platinum alloy. Gold, and more particularly silver, are also widely used for crucibles and dishes. There are naturally many variations from the standard design of crucible, one of the most popular of the more unusual types being the Gooch crusible. This crucible includes an asbestos or platinum sponge filter bed and cover, and is used for filtration in quantitative analyses where ignition of the precipitate in contact with paper is not permissible, for example in the case of $MgNH_4PO_4$ and $PbSO_4$. Other unusual types of crucible are the tubular Gooch crucible with forked tubular cover, and the Lawrence Smith crucible shaped like a test-tube, which is used for the determination of alkalies in silicates.

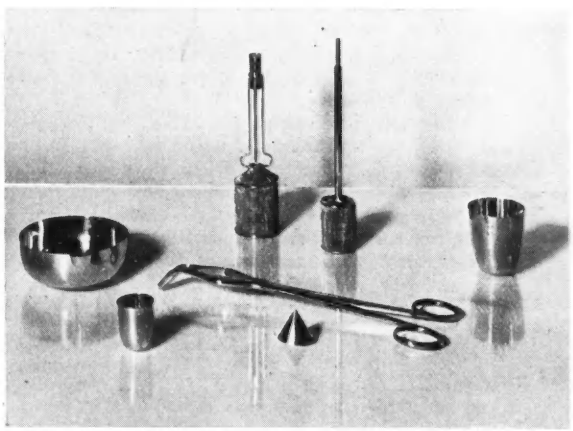
Although the standard methods of analysis proposed by various scientific associations recommend various slight modifications in the usual crucible design, it is interesting to note that most of the more popular types of crucibles, and apparatus, have not altered from their original design of 60 and more years ago

Electrolytic Analysis

Platinum electrodes are used in a great number of methods of electrolytic analysis, the most common design being that of Dr. Sand, which consists of a pure platinum gauze mounted on a frame of 10 per cent. iridio-platinum alloy. Owing to the high resistance to corrosion of platinum, electrodes may be made of thin foil or wire or even of a platinum-coated base metal, such as nickel or copper. Exceptionally small platinum electrodes are also used in conductivity cells. The characteristic features of all the electrodes are their highly burnished finish and the absence of any awkward corners and bends that might possibly entrap liquor during rotation.

Plugs in alkali burettes and alkali moulds are often made of silver, and quite recently a new type of stirrer incorporating a corrosion-resistant silver-copper alloy was introduced. This new stirrer consists of looped wires of the alloy to replace the propeller on the usual type and it has been found very satisfactory for stirring exceptionally thick mixtures.

No laboratory is complete without an electric furnace and platinum furnace windings are essential where particularly high temperatures are required, such as in the determination of carbon in steels. Alundum protection tubes are usually employed with such furnaces which can be used for a number of combustion methods and for ordinary melting purposes. Muffles, tubes and thermo-couples are in a kindred sphere; platinum,/platinum-10 per cent. rhodium,/platinum-13 per cent. rhodium alloys are widely used for high temperature measurements on account of their stability and extraordinary good reproducibility.



Platinum Laboratory Apparatus (Johnson, Matthey and Co. Ltd.)

Platinum capsules and electrodes are used in a number of bomb calorimeters such as Berthelot-Mahler and Mahler-Cook. In addition, the steel bomb itself may be lined with solid platinum, gold with a silver backing, or platinum-faced copper sheet. Among other pieces of apparatus usefully employed in the laboratory may be mentioned thick-bottomed dishes, capsules of special hard alloys, spoons for combustion and fusion tests and for general use, incinerating pans, dishes for electrolytic analysis, blow-pipe tips, triangles, platinum-tipped crucible tongs, iridio-platinum spatulas, parting apparatus for gold and silver, filter cones, etc.

Care and Maintenance

It is a mistake to assume that precious metal apparatus can be used for anything. Platinum is unattacked by any single acid, but (like gold and silver) is dissolved readily by aqua regia. It can be heated up to its melting point in air or oxygen without oxidising, but when heated in the presence of highly carburetted gases, it takes up carbon, part of which remains in solid solution, the rest being precipitated as graphite on cooling, with the consequent embrittlement of the apparatus. Thus excessive heating, for example, in the reducing flame of a bunsen should be avoided. In this connection it should also be borne in mind that platinum at high temperature is permeable to hydrogen which diffuses through the metal and in prolonged ignitions may cause errors in analyses by reducing any oxides that may be present. In addition, the reduced metal may attack the platinum to form

low melting alloys. The diffusion of hydrogen is augmented by the relatively rapid grain growth of platinum on prolonged heating at high temperatures. The development of this coarse grain structure is the common cause of failure in platinum crucibles, since it causes any brittle impurities present to segregate to the grain boundaries. The addition of iridium, or preferably rhodium to platinum, tends to restrain grain growth and to diminish the grain size of the recrystallised metal, but the safest course is to avoid prolonged heating at temperatures above 1,000° C.

At high temperatures platinum is attacked by arsenic selenium and mixtures of their compounds, or of those of sulphur or phosphorus, with reducing agents, as well as by fused caustic alkalis, alkali nitrates and cyanides. Metals such as lead, tin, zinc and bismuth, should not be heated in platinum crucibles and dishes, as they readily form low-melting alloys with the platinum.

Hot crucibles and dishes should always be placed upon some clean refractory material to cool and not upon a metallic surface, especially rusty iron, where they are likely to pick up impurities. After use, the apparatus can be kept in excellent shape by placing it in box-wood formers which are supplied by the makers of the apparatus.

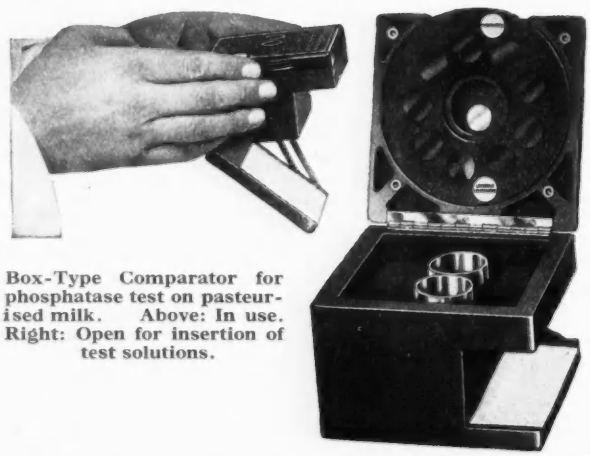
The best materials for cleaning platinum and other precious metal apparatus are alumina and heavy magnesia of the grade used for polishing. Silver sand may be used so long as it is borne in mind that an extremely hard material is being used against a soft metal. Care should be taken that the platinum is not unduly scratched, and only the finest grade of sand with the particles well rounded and free from sharp edges should be used. In many cases, sand or similar abrasives are not necessary. If the apparatus cannot be cleaned with alumina or magnesia, satisfactory results can be obtained by fusing potassium bisulphate or carbonate in the crucible or dish.

Colorimetric Determinations

Tintometer Progress

THE past twelve months have seen considerable progress in (a) the colorimetric chemical estimation of various elements, and (b) colorimetric grading and standardisation of commercial products.

The general colorimeter manufactured by The Tintometer, Ltd., and known as the Lovibond tintometer, British Drug Houses Pattern (Brit. Pat. 299194), has been successfully employed in many directions; reports have been published on such widely divergent subjects as biochemistry, metal analysis, food adulteration and the deterioration of oil paintings. To add to the comfort of their customers and to assure maximum



Box-Type Comparator for phosphatase test on pasteurised milk. Above: In use. Right: Open for insertion of test solutions.

sensitivity of the observer an adjustable table and chair and an enclosed observation cubicle have now been added to the accessories available for this useful instrument.

The range of discs available for the Lovibond comparator and the B.D.H. Lovibond nessleriser has been extended and a formidable list of tests is now available for *p*H determinations, water analysis, detection of food adulteration, medical tests, etc. Discs have been approved for the grading of commodities such as cresylic acid, low boiling fractions of coal tar, and the new acid wash test on liquid paraffin (B.P. Addendum) has been standardised in terms of the Lovibond colour scale.

In conjunction with the National Institute for Research in Dairying at Shinfield, the box-type comparator (Figs. 1 and 2) has been designed and placed upon the market for performance of the phosphatase test on pasteurised milk.

The phosphatase test, originated by H. D. Kay and W. R. Graham, jun. ("J. Dairy Research," 1935, Vol 6, No. 2) depends on the detection of the enzyme, phosphatase, which is always present in raw milk, but is destroyed at the temperature necessary for efficient pasteurisation. The absence of phosphatase indicates that the milk has been adequately heated, while its presence points to insufficient heating or to contamination with raw milk. When milk containing phosphatase is incubated with disodium phenyl-phosphate, free phenol is liberated and the quantity so liberated, which may be determined by a colorimetric method, is an approximate measure of the phosphatase present in the milk.

Among accessories The Tintometer, Ltd., now offer British-made all glass acid, alkali and solvent proof cells. Although these cells were primarily designed for use in the tintometer they are equally suitable for use with colorimeters, saccharimeters and other optical instruments.

New Technical Books

"SPRECHSAAL YEAR BOOK FOR CERAMICS, GLASS AND ENAMEL, 1937" (Sprechsaal-Kalender für Keramik, Glas, Email 1937. Edited by Dr. J. Koerner, Coburg. 406 pp. Verlag des Sprechsaal, Müller and Schmidt, Coburg.

The technical section of the Sprechsaal Year Book has developed, during several decades, a splendid tradition, and has from year to year more valuable matter and is still further improved. The book can therefore be highly recommended as a valuable collection of technical data. The first two chapters: "National Socialism and Technique" and "List of National Remembrance Days" are brand new.

* * *

"CERAMISTS' ANNUAL 1937," two parts. Text, 431 pp. (Taschenbuch für Keramiker 1937. 2 Bde. Textbd. 431 S.) Chemisches Laboratorium für Tonindustrie und Tonindustrie-Zeitung. Professor Dr. H. Seger and E. Cramer Kom.Ges. Berlin, NW.21.

The "Ceramists' Year Book 1937" contains in the section for the subject matter, chapters which make it for the chemist as valuable as it is interesting. Chapters particularly worthy of note are those dealing with "Laboratory Porcelain," "Engineering Material for Chemical Apparatus," "Acid Resisting Stoneware," "Drain Pipes," "Refractory Materials," "Glass for Laboratory Appliances," and "Enamel Ware." The numerous other articles, tables and references make the book interesting and valuable.

Interchangeable Conical Ground Glass Joints

By J. WILSON

GROUND glass joints were probably embodied in chemical apparatus in order to avoid, with certain reagents, the use of corks and bungs. Standardisation was an obvious next step, and many patents to this end were taken out. In spite, however, of the time and money expended, various "snags" prevented the realisation of the idea, until quite recently. The Germans were the first to succeed, and the first to draw up a standard specification for interchangeable conical ground glass joints, a specification which has since been adopted both in this country, and in the United States.

Until recently the design of chemical apparatus has been governed more by the requirements of glass blowing than of chemistry, a state of affairs which has at times produced some rather curious results. It is quite possible, therefore, that the original decision to standardise the 1 in 10 taper was reached, with little or no attempt to consider carefully the chemist's viewpoint. Once a standard had been adopted, trade interests, always strongly represented on standardisation committees, would be more concerned to draw up a specification which protected existing procedure, than to produce something which was fundamentally sound, though possibly a little revolutionary.

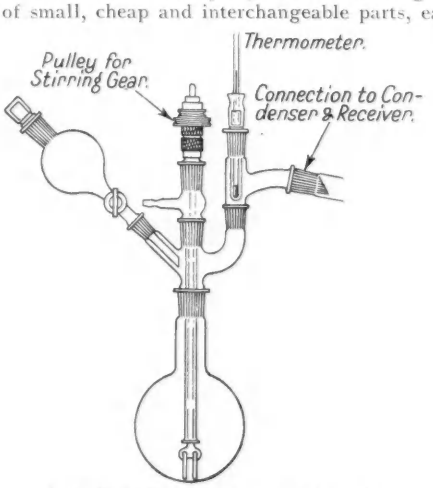
Now it is by no means certain that a taper of 1 in 10, the taper for interchangeable ground glass joints specified by the British Standards Institution, is actually the best taper to use. For joints with a taper of approximately ½ inch it is probably not far wrong, but for wider joints, particularly where the joint is under pressure, *e.g.*, in the case of an adapter connecting a flask with a fractioning column, a taper of 1 in 10 is insufficient and there is often considerable difficulty in taking the apparatus apart later. A taper of about 1 in 6 would be more suitable, since it would give a joint that could be more easily broken when desired. In the case of a joint approximately ½ inch in diameter, connecting, say, the end of a still head adapter with a condenser, as in distillation, we have a joint liable to be broken spontaneously by the vibration of boiling, stirring, etc. Here, therefore, a joint giving good adhesion is essential, and a taper of 1 in 10 is quite suitable. But in the case of joints less than approximately ½ inch in diameter, a taper of 1 in 10 is excessive, and still less taper is desirable, if the joint is to bond properly.

A Missed Opportunity

The existence of more than one taper would not have complicated or confused the specification, because if male and female conical surfaces are to mate completely they must agree as to diameter, taper and length. For each size of joint a definite taper could have been specified, for size considerations alone would prevent anyone attempting to put, say, a size six cone into a size four socket. A difference in the taper of sizes six and four would not therefore cause confusion, at any rate as far as the user was concerned. The only person who might have been inconvenienced by any such a decision would have been the manufacturer, since the mechanic responsible for the casting and grinding tools would have been compelled repeatedly to reset the taper turning attachment of his lathe. The difficulties, at any rate, were not insuperable. It is not suggested that there should have been a special taper for each individual size of joint, but only that joints should have been divided into about three or four groups, and that after careful tests, an optimum taper should have been selected for each of these size groups.

In spite of the drawbacks of the present standard taper, however, apparatus built up from standard interchangeable parts offers inestimable advantages to the chemist. It provides him with the means for carrying out any operation desired, filtration, distillation, fractionation, extraction, etc. Moreover, he can switch over from one operation to another very quickly; no trouble is incurred in finding the right cork, boring holes, bending tubing, etc.; everything drops into place at once, like a key into a lock. No matter how quick the change-over, owing to the care and thought put into the design of individual parts, the resultant assembly is always neat, and pleasing.

A glance at a manufacturer's catalogue will show at once the enormous range now offered. There is, of course, all the usual apparatus for distillation, under normal or reduced pressure, with means for working in special atmospheres, and for keeping the distillate free from contamination. But we particularly note such new features as the reflux ratio head whereby a definite and known proportion of the distillate may be returned down the column, an extremely useful part for the research chemist getting his "prep" into shape for small scale production trials. Or again, the fractionating column built up of small, cheap and interchangeable parts, each one



A typical laboratory assembly with interchangeable ground glass joints.

a perfect substitute for the plate of an industrial column, the whole forming an extraordinary combination of simplicity, adaptability and usefulness.

We note, too, the very simple yet efficient means provided for stirring the contents of a flask, an improved form of Wyllie extractor, a liquid estimation apparatus, a micro distillation apparatus, an interchangeable stop cock, a condenser which does not get fogged on the outside, and everywhere, in the thickness of the inner condenser wall, in the angle of the condenser side tubes, in the provision made for thermometers, in the pip on the receiving adapter, in the special draining tip on the micro distillation apparatus, everywhere, evidence of concentrated thought.

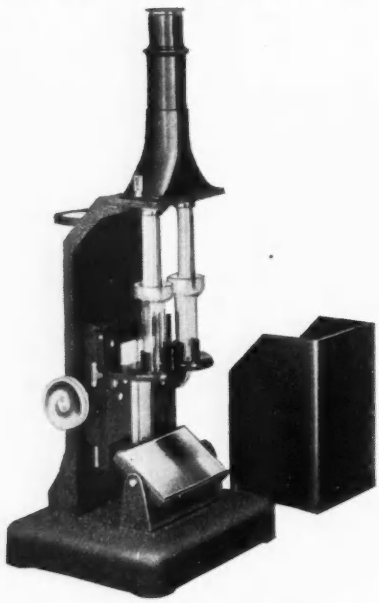
The chief disadvantage of interchangeable ground glass joints is a tendency at times to seize up. This is due either to assembling parts made from different kinds of glass with different expansion coefficients, or to the selection of an incorrect lubricant, though one contributing factor is a faulty choice of taper by the British Standards Institution Committee. Finally, when one considers the number of Winchester reagent bottles in use, each with its own ground glass stopper; when one considers what this must mean to a firm with thousands of such vessels, to wash daily; when one considers, too, how many countless thousands of sweet bottles there are, each with its own individual stopper; when one considers the scores of places in industry where a standard interchangeable ground glass joint could be employed with advantage, one begins to realise the unlimited possibilities of the fundamental idea, and how much remains still to be accomplished.

Colour and Concentration of Solutions

Use of the Duboscq Colorimeter

THE Duboscq colorimeter is rapidly becoming a necessity of most laboratories. It furnishes a ready means of measuring the contents of a solution which has colour sufficiently stable to last through the measurement. This type of colorimeter was first devised by Jules Duboscq in 1854, and the optical and mechanical refinements which have since been added furnishes an instrument which is essentially a high grade photometric apparatus.

The resources of the Bausch and Lomb Optical Co., Ltd., has been devoted to the production of these colorimeters. The instrument is made in four sizes. The 20 mm. outfit is suitable for dense solutions, the 40 mm. and 50 mm. model can be used for general purposes, while a 100 mm. instrument provides ample scope for very light solutions. A special feature of importance is the extra large eye-piece aperture, which is 2½ mm. in diameter. This corresponds closely with the aperture of the pupil of the eye, and avoids the constant contraction and expansion of the pupil in an effort to adjust itself during the period of observation.



The Duboscq Colorimeter
(Bausch and Lomb Optical Co.)

Proper attention to the illumination of the instrument should not be overlooked and, where daylight is relied upon, a window facing the north should be selected. Having placed the colorimeter directly in front of it, while looking into the eye-piece turn the mirror until the maximum amount of light is obtained. If necessary, slightly alter the position until both halves of the field are of equal intensity. Since daylight is constantly altering in intensity and colour which introduces some difficulty in maintaining a contant balance, it is still more satisfactory to employ a good colorimeter lamp for routine work, which is attached to the colorimeter in place of the mirror.

There are four elements in colorimetric calculations:—(1) Concentration of standard which is known; (2) scale setting for this standard; (3) concentration of the sample, the value of which we want to know; (4) matching No. 3 with No. 1 simply by altering the position of No. 3 cup by rack and pinion adjustment and reading off the value on the scale when the two sides match.

The colorimeter behaviour of most substances may be expressed by a simple law, that is, the colour of a solution varies proportionately with the concentration. This means that the smaller the amount of substance present, the weaker will be the colour and vice-versa. In most colorimetric work it it assumed that this proportionality is mathematically exact, and on this assumption is based the simple calculation by which the concentration of a sample is determined. Therefore, having matched the sample with the standard solution, the relation of these two values is such that if we divide the setting of the standard by the setting of the sample and multiply the result by the concentration of the standard, we have the concentration of the sample.

Removal of Fumes

Asbestos Cement Ducts Widely Adopted

ASBESTOS-CEMENT ducts are being widely used in laboratory construction. Metals are obviously unsuitable and "Everite" anti-acid ducts have solved a real difficulty. The accompanying illustration shows the asbestos-cement ducting recently installed in the new laboratories at Birmingham University. The fumes from the cupboards in this particular installation are fan-lifted, and there is an asbestos-cement damper. The fumes are carried up into large square ducts which are also made of asbestos-cement. It will be noticed that where the ducting from the cupboards is joined to the square ducting, the sockets are internal in order to give a flush fitting throughout its length; this stops dust accumulating and allows the ducts to be kept clean easily. The inside of the circular and square ducts are kept smooth to maintain a low co-efficient of friction and asbestos-cement, owing to its structure helps to eliminate fan-ring. Installations of asbestos-cement ducting have been made recently at the Sir John Cass Technical Institute, London; Bristol University; the Herriot-Watt College Extension, Edinburgh; and the new Chemistry Block, Leeds University.

"Everite" anti-acid asbestos-cement ducts installed to extract fumes from the fume cupboards in the laboratories of the new Birmingham University extension.

A NEW company under the name the Jubbulpore Chemical Co. has been registered in India with a capital of Rs. 700,000 with its registered office at Jubbulpore, C.P., which will work the copper and bauxite deposits of Jubbulpore for the manufacture of copper and aluminium sulphate very cheaply. The bauxite deposit has been proved to contain 200,000 tons of bauxite and the copper mine is expected to contain at least 100,000 tons of copper ore with an average 4 per cent. copper. The company will begin by establishing a sulphuric acid plant at Sleemanbad, and this acid will be used for the manufacture of copper sulphate, aluminium sulphate and other acids such as hydrochloric and nitric acid.

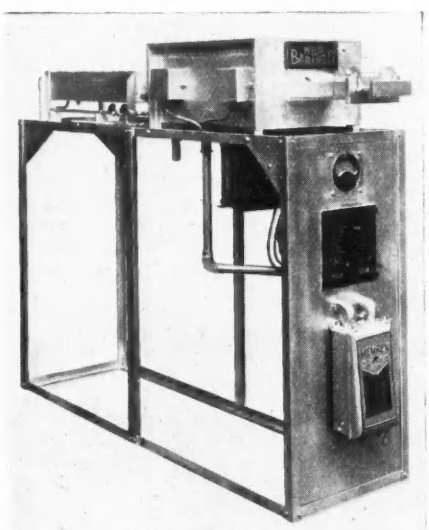
Some Special Electric Furnaces

By G. D. LAMB, B.Sc., A.C.G.I.

OCCASIONS frequently arise when standard electric furnaces are not exactly suitable and when a specially designed furnace can be used to better advantage or is actually essential. That is the experience of Wild-Barfield Electric Furnaces, Ltd.

One very widely used furnace is of the tube type, with say, a length of 16 in. and an internal diameter of 2 in. In many cases combustions and reactions are carried out in the furnace itself, but more often than not it is necessary to employ a gas atmosphere. In this case it is usual to use a removable silica tube some 12 in. longer than the furnace, which can be fitted with bungs into which gas connections can be made, so that the gas can be passed continuously over the material in the furnace.

Normally, laboratory requirements are covered by nickel-chromium or platinum wound furnace, the latter being suitable up to about 1,400° C., but where higher temperatures are required molybdenum must be used for the heating element. Molybdenum, however, rapidly oxidises in air, and special precautions must be taken when it is used. It is usual to



Electrically-heated Furnace of special design with internal atmosphere of hydrogen. (Wild-Barfield Electric Furnaces, Ltd.)

make the case of the furnace gas-tight by using a welded construction except at the top which is bolted down to make a sealed joint. Hydrogen is passed into the case itself, which removes the air from the insulating bricks. It is necessary to purge the furnace in this manner before the current is switched on to the heating winding. The hydrogen supply must be kept on during the whole period of use and whilst the furnace is cooling down.

To avoid delay when changing the bottles of hydrogen it is usual to have two bottles in use at a time, with a change-over valve so that as soon as one is exhausted the other can be used without failure of the hydrogen supply to the furnace, which might damage the molybdenum. The accompanying illustration shows a molybdenum-wound furnace which has a water-jacketed extension to the furnace for cooling the work after heating. In this furnace, hydrogen is passed into the furnace chamber as well as into the case. To compensate adequately for the high temperature co-efficient of resistance of molybdenum, a tapped transformer with tapping switch is fitted.

Several furnaces, which were required to rotate while heating, have been built by Wild-Barfield Electric Furnaces, Ltd. These small furnaces with chambers about 5 in. diameter by 10 in. long, are mounted on their sides and rotated by a chain and motor. Current is led to the furnace winding through two slip rings.

Where it is required to heat large sized tubes, say 5 in. in diameter, at temperatures between 1,000° C. and 1,400° C. it is not practicable to employ platinum for the winding and in such cases, recrystallised carborundum elements are used. These furnaces are controlled by a tapped transformer and tapping switch to compensate for the increase in resistance of the heating elements with age.

Low temperature ovens are used to a wide extent for many purposes requiring temperatures up to 300° C. For such, single skinned aluminium ovens or double skinned insulated ovens are employed, the latter at about 150° C. or in the case of large ovens for lower temperature.

Silicon in Iron

A New Method of Determination

A NEW method has been evolved by E. Leitz (London) for the rapid determination of silicon in iron and steel with a simplified model of their Leifo photometer. Use is made of a special mercury vapour lamp and violet filter, the wave length of the light used being 436 $\mu\mu$. This light is divided into two beams, one of which passes through the solution, the silicon content of which is to be determined, while the intensity of the other is varied by means of two nicol prisms, one of which rotates against the other. The yellow colour, the intensity of which is in direct relationship to the silicon content, is produced by the well-known silicic acid—molybdenum reaction. The novel chemical method evolved for the elimination of all other substances which might affect the result enables a silicon determination to be carried out in approximately 20 minutes instead of the usual period of several hours. The accuracy of the method is approximately ± 5 per cent. in the case of silicon contents above 1 per cent., and in the case of lower silicon contents it is approximately ± 10 per cent.

Temperature Controlled Ovens

Equipment for the Rubber Testing Laboratory

LABORATORY control in the processing of materials is being increasingly applied in every direction. One phase of this control is directly connected with the consideration of temperature and its accurate maintenance in the manufacturing processes of such products as metals, rubber, plastics, textiles, chemicals, paper, foodstuffs, etc. Further, the success of attack, in the effort to improve materials, largely depends upon the efficiency of laboratory apparatus which is used for control investigations.

To-day, rubber, to cite one material, is receiving intense attention from the works laboratory chemist and the recently developed Hearson temperature controlled ovens have had a ready acceptance in ageing investigations of mechanical and technical rubber products. Included in the range of Hearson equipment is an oven for the Geer test, fitted with internal rotor for sample suspension; an oven with dual thermostats 25° C. and 50° C. interchanged at specified time intervals by synchronous motor and switch; ovens with motor driver rotating plate and hangers—electrically heated and controlled, ovens for the dry heat test at 70° C., plastometer test, plastic yield determination, and accelerated ageing test.

The Hearson oven electrically heated, thermostatically controlled with mechanical convection features is almost revolutionary in design and has wide application for many purposes.

Micro-Chemical Analysis

Use of Platinum Apparatus

UNTIL recent years, micro-chemical analysis was used almost exclusively in research work dealing with special materials, or in very precise work on atomic weights. With the development of assay balances of great sensitivity, micro-chemical methods have been made more generally available, and to-day they play an important part in general analytical practice.

The reactions employed are exactly similar to those used in macro-analysis, the scale of operations being reduced so that work can be conveniently and accurately carried out with a few milligrams of material in a few cubic centimetres of solution. In addition to the saving of materials and space required for a given type of work, the strongest appeal of these methods lies in their neatness, speed and accuracy. Perhaps their greatest practical advantage is in the saving of time involved; all the usual operations of analysis—heating, evaporating, drying, etc.—are much more rapidly carried out with small quantities of material. Determinations of carbon and hydrogen by micro-combustion show such a saving of time, amounting to several hours in each determination, that the older methods are now passing out of use

Processes of filtration are carried out by means of platinum filter sticks fitted with porous diaphragms; ignitions and evaporations are done in small platinum boats and capsules. Mention may also be made of various types of micro-apparatus for electrolytic analysis which embody similar advantages in speed and accuracy of manipulation. To meet the increasing demand, a comprehensive range of platinum micro-chemical ware has been designed by Baker Platinum, Ltd.

Laboratory Water Softeners

Effective Treatment of Hot Water

WITH nearly forty years' experience in the manufacture of industrial water-softening plant, Watsons Water Softeners, Ltd., are now supplying small water softeners of a size suitable for installation in the laboratory. This company is the only water-softening concern in this country manufacturing its own base exchange medium, and the founder, the late Mr. H. B. Watson, was responsible for the development of the upward flow system in all Nat-Rol machines. He also introduced an adjustable screen, the only one of its kind, which prevents the mineral from escaping into the service lines. All the Nat-Rol plant can be used on hot water supply without risk, and it is claimed that Nat-Rol is the only softening mineral that will treat hot water without loss of efficiency.

Softening capacities are guaranteed for five years. The portable machine illustrated is designed to soften, between regenerations, 80 gallons of water with 16° hardness, and can be used off hot and cold taps, either separately or simultaneously. It has a remarkably high rate of flow, 120 gallons per hour, and the upward flow system on which it works is stated to obviate all back-flushing.

The "Nat-Rol" Water Softener (Watson Water Softeners Ltd.)

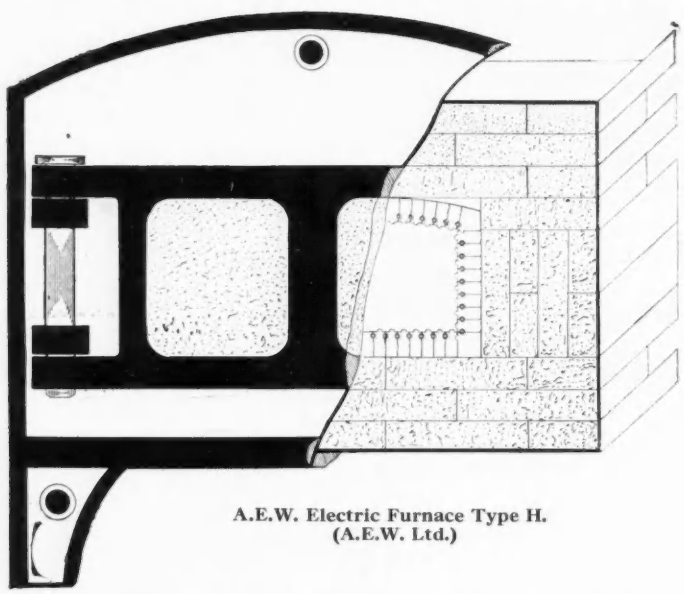
A Modern Electric Furnace

Many Unique Features

THE economy and low maintenance costs of electric furnaces are dependant upon the life and easy replacement of the elements. The chief causes of short life are mechanical strain set up by the expansion and contraction of the elements and refractory chamber, also, when the element is wound on the outide of the refractory chamber it must be run at a higher temperature to transmit the necessary heat into the inside of the chamber.

The A.E.W. electric furnace supplied by A.E.W., Ltd., overcomes these difficulties. The elements are quickly and easily renewed by any engineer without dismantling the furnace. The costs of replacing the elements are very low. The elements being close to the inside of the refractory chamber with free heat circulation, higher temperatures can be obtained without over-running the elements. They are, moreover, freely supported in the channels of the chamber and are free to expand and contract without any mechanical strain. The refractory chamber, being of substantial thickness, is mechanically strong, resulting in very long ife.

The basic design of the A.E.W. Type " H " electric furnace is that the refractory chamber is built up of large section refractory bars interlocked in such a manner to allow for expansion and contraction. The elements are carried in channels running from back to front and elements passing through these channels are connected to busbars at the back of the furnace and designed in such a manner to allow for easy replacement. The refractory chamber is insulated by high quality heat insulating bricks of such thickness to reduce heat losses to a minimum. The chamber and heat insulating bricks are built into a strong and robust iron framing with cast iron end plates and door mechanism of substantial construction to withstand rough usage in workshops, etc. These furnaces can be arranged with self-contained temperature regulators or three-heat control switches.



A.E.W. Electric Furnace Type H. (A.E.W. Ltd.)

Lamp Blown Glassware

Manufacturers Exceptionally Busy

BUTTERWORTH BROS., LTD., of Newton Heath Glass Works, Manchester, have a history dating back to the year 1795, in the reign of George III, when the earliest of their constituent companies was founded. Among the original products were glass accessories for the textile and woollen industries, the demand for which increased greatly when spinning and weaving was transferred from cottage homes to power-driven mills. In the course of time the range of manufactures has been widely extended and now includes most kinds of glass required for mechanical, scientific and industrial purposes. Mr. Walter Butterworth, thrice president of the Society of Glass Technology, was chairman of the company from 1894 to 1935. In 1927 the business of Robert B. Clarke and Co., lampblown scientific glass makers, was acquired, and the production of their special types of glassware was commenced. During the past twelve months the lampblown glassware department has been exceptionally busy. Increased activities have made it necessary to call upon the Manchester Corporation to lay a larger gas main for supplying this part of the works. In a number of instances the company has been producing apparatus which has formerly been made only on the Continent. The lampblown glassware department is equipped for making all varieties of apparatus for chemical laboratories.

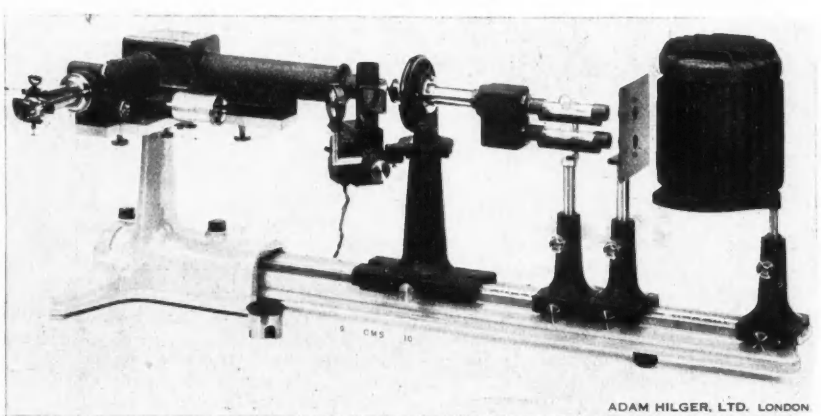
Investigations by Spectra

Some Improved Instruments

A MEDIUM size quartz spectrograph has been introduced by Adam Hilger, Ltd., in which the optical system has a flat local plane so that any inconvenience that may be occasioned by the necessity of using thin plates that will bend to the curvature found in other instruments is avoided without loss of definition. This instrument (whose spectrum from 10,000Å to 2,000Å is photographed on one 10 in. by 4 in. plate) has proved the most useful size for general spectrographic analysis. An accessory instrument of great importance to the practising spectrographer is the Judd Lewis spectrum comparator, since it enables spectra taken on different plates to be compared with one another with the greatest ease and rapidity. This has been completely redesigned and is now constructed entirely in metal. The open design of the stages, permitting the examination of wet negatives, has been retained. For the accurate measurement of the separation of spectrum lines a new micrometer of small size has been introduced under the name of the Spekker photomeasuring micrometer. This instrument measures over a total range of 75 mm. with a tested accuracy of 0.005 mm.

The Hilger constant deviation wavelength spectrometer has also been the subject of extensive revision of design which has rendered it possible to convert it to any of a range of instruments which includes spectrographs, monochromators, infra-red spectrometers, visual spectrophotometers, etc. Its utility in the laboratory has been considerably extended. The separate parts which are used in making the conversions are of co-ordinated design so that they may be assembled in place with the greatest ease and are certain to perform their functions with the maximum of efficiency.

The Spekker photoelectric absorptiometer has been the subject of extensive revisions of design with a view to increasing its accuracy and convenience of operation. It is now much more compact in design than formerly and is provided with a larger diameter drum on which readings can be taken with improved accuracy. The makers claim that it is based on the only sound design for a photoelectric colorimeter. It is so arranged that its readings are unaffected by variations in line voltage and are not dependent upon the relationship between the current given by the photocell for a given intensity of incident light. Readings are given directly in densities and are approximately linear with the solution concentration.

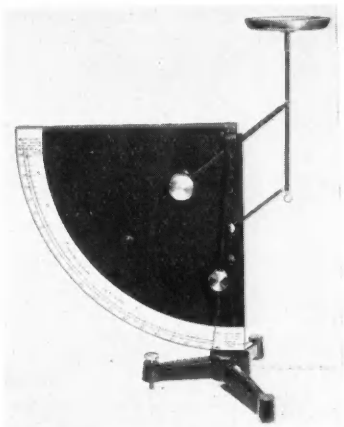


Hilger Barfit Wavelength spectrometer arranged as a visual spectrometer.

Rapid Weighing Out

A Useful Laboratory Lever Balance

WITH a " Butchart " rapid-weighing lever balance a weighing can be taken in a few seconds with the great advantage of dispensing with the use of weights, thus eliminating the risk of possible error in adding (and incidentally avoiding the loss of small weight). The Principle of Archimedes can quickly be verified by using the hook at the end of the vertical arm, or, alternatively, the down-thrust on a liquid can be shown by suspending the solid in a beaker placed on the pan. The scale, which is graduated in grms. and ounces, should prove instructive in showing the relationship between the metric and avoirdupois systems, and the graduations, being large and bold, make the balance useful for class demonstration purposes. As a " weighing-out balance " it should prove invaluable. A suitable removable pan can be provided for that purpose. The adoption of " Butchart " balances in laboratories would be an economically sound proposition, both as regards time saving and expense, as it will readily be seen that the immense saving of time in manipulation would reduce the actual number of balances required.



The Butchart rapid weighing lever balance.

The " Butchart " balance, which is supplied by W. B. Nicholson, is designed on the lever principle, the pivots being of tough stainless steel. There is a scale with black figuring on silvered brass, graduated in grams and ounces on the outer and inner arcuate edges respectively. The total height of the balance is 19 in. There is a hook at lower end of the vertical arm for specific gravity work.

Annual Report of Imperial Chemical Industries, Ltd.

New Sales Records

THE report to be presented at the tenth annual meeting of Imperial Chemical Industries, Ltd., in London next Thursday records that the year was notable for increased prosperity in most branches of industry at home, with an appropriate growth in the company's sales of practically every product. In many instances new records were established. Trade in export markets was on the whole good. Competition from Japan continued on a large scale, but there are signs that the vigorous resistance with which it has been met is having effect. Barter business was again in evidence, but there appeared to be less tendency for it to be related to directly competitive products.

Conditions Overseas

India denounced the Ottawa Agreement, which thus technically expired in November, 1936, but preferential duties are being maintained pending the negotiation of a new commercial agreement. Conditions in China improved partly in sympathy with the general economic recovery and partly owing to the gradual development of a larger measure of political unity. In the Near East an improvement in trading relations with Turkey and Egypt must be offset against the difficulties which arose in Palestine, and to a lesser degree in Syria and Iraq. Business with Spain has naturally suffered severely through the civil war. The Government's re-armament programme has naturally resulted in increased activity in the company's business.

In the alkali group the continued improvement of trade in the British Isles, notably in the glass and rayon industries, led to an increase compared with 1935. Exports to the British Empire continued to be satisfactory. Good progress has been made with the Australian enterprise centred at Port Adelaide. The extensive salt fields have been completed, and are now being filled. The construction of the alkali manufacturing plant will progress in 1937. In India, it has been decided to build an alkali factory in the salt range of the Punjab.

Business in the dyestuffs group expanded during 1936 at approximately the same rate as during 1935. The demand for dyestuffs in the home and overseas markets showed an improvement, particularly in India. An advance was also recorded in the sale of the miscellaneous products.

With increased activity in mining, both at home and abroad, sales of blasting explosives and their accessories rose considerably. At home, there was barely the average activity in public works requiring explosives. In coal mining, however, a fuller use of explosives is obviously being found of service. In certain markets abroad competition has been intensive at prices which appear to be dictated by a policy of getting business at any price, notwithstanding an increased cost of production.

Rapid Expansion of Fertiliser Sales

The consumption of fertiliser nitrogen in the home market continued to increase in 1936, being about 9 per cent. over 1935. The company's sales, including the by-product sulphate of ammonia produced by members of the British Sulphate of Ammonia Federation, amounted to about 70 per cent. of the home demand. The home sales of the company's special fertilisers have expanded rapidly, those of nitro-chalk by 25 per cent. and of concentrated complete fertilisers by 35 per cent.

The coal hydrogenation petrol plant ran throughout the year. Various temporary difficulties of the kind to be expected in a new and unique enterprise of this magnitude restricted the quantity of coal treated during the year. The deficiency was made up to some extent by increasing the volume of creosote oil and low temperature tar hydrogenated. The total consumption of coal for petrol production from both coal and tar oils was 425,000 tons. The output of petrol was 112,000 tons, or 33 million gallons. A plant for the manufacture of hydrogen from the hydrocarbon gases has been put into successful operation.

Sales of chlorine products again made progress. Demand for mineral acids improved, while that for organic acids remained steady. Miscellaneous chemicals benefited by the general increase in industrial activity in the country.

Development and expansion of the use of the product of the leathercloth group continue. The possibility of widening the field of consumption has become a definite accomplishment, resulting in additional business, particularly in the perambulator and decorative trades. The capacity of the factory continued to be taxed to the utmost, and extensions are in progress.

There was a good demand for the company's lime, cement and plaster products, and the output of the lime kilns constituted a fresh high record, being slightly in advance of the 1935 figures.

Sales generally in the metal group during 1936 were well maintained. There was some falling off in export trade, particularly in India. This was, however, more than counterbalanced by an exceptional increase in demand from home consumers. That improvement was fairly widely spread, and was particularly evident in wire, rod, and tube products and the shipbuilding, motor, telephone and heavy electrical industries. Calls on productive capacity in connection with the Government's rearmament programme were met without interfering with normal business. The various metal factories with the exception of that at Swansea (where much of the plant is suitable only for the specialised requirements of the Indian trade) worked throughout the year at high pressure.

The Paint and Lacquer Group

Nobel Chemical Finishes, Ltd., and its subsidiary company operated in 1936 for the first time as an entirely owned group. In the industries for which the group caters, and particularly in the motor trade, the volume of business considerably exceeded that of the previous year. As a result of some years of continuous research, a new and distinctive type of oil emulsion water paint has just been put on the market, under the name of "Beldec."

The growth of the plastics industry continues without interruption and the company's turnover in products used therein has expanded materially. Extensions to all existing plants have been made during the year, and for greater ease and economy in working it has been decided to construct an up-to-date factory, at which will be concentrated the bulk of the plastics manufacture, administration and research.

The company's research activities have been maintained on an undiminished scale. In the textile industry there has been a rapid development of chemical finishes for imparting a wide variety of effects to fabrics, including special permanent finishes, which are particularly resistant to laundering and dry-cleaning. The research laboratories have actively co-operated with the sales organisation in producing these new materials. The work of the agricultural research station at Jealott's Hill has been reorganised and extended.

The growing importance and scope of metallurgical research has led to the building of a new laboratory for the metal group, equipped with up-to-date plant, in which it will be possible to carry out experimental and development work on pilot plants without interfering with normal production routine. A similar development is taking place in the dyestuffs group, where activities are being extended to new branches of the organic chemical industry.

The number of employees in Great Britain is approximately 56,000 as compared with 53,500 a year ago.

Personal Notes

MR. C. A. ROWE has resigned from the board of Goodlass Wall and Lead Industries, Ltd.

MR. T. E. FELLOWS, MR. J. C. MANN, MR. B. E. W. ROBINSON, and DR. F. R. TUNKS have been appointed directors of Midland Tar Distillers, Ltd.

MR. G. LESLIE WATES has been appointed chairman of Canning Town Glass Works, Ltd., in place of Sir Rowland F. W. Hodge, who has resigned but remains a director of the company.

MR. J. BALFOUR SHEDDON, Mid-Calder, one of the most prominent figures in the Scottish oil industry, has retired. A native of Newtown, Bo'ness, Mr. Sheddon began his mining career with Young's Oil Co., at West Calder, and was for many years manager of the Oakbank Oil Co. On the incorporation of the various oil companies in Scottish Oils, Ltd., he was appointed mining agent for the western group of shale and coal mines. A past president of the Scottish Institute of Mining Engineers, Mr. Sheddon for many years served as a member of Midlothian County Council, and is chairman of the education committee. He received the O.B.E. in 1935 for his public services. A company of 100, representing the staff and workmen of the shale mines, met at Mid-Calder and presented Mr. Sheddon with a gold watch and binoculars on the occasion of his retirement. Mr. Stein, managing agent, presided, and the presentation was made by Mr. Borlan, of West Calder.

MR. CHARLES F. POOLE, of Sandbach, Cheshire, formerly a director of Brunner, Mond and Co., left estate valued £36,945, with net personalty £32,521.

PROFESSOR P. M. S. BLACKETT has been awarded the Hopkins Prize of the Philosophical Society at the University of Cambridge, in respect of his researches on cosmic radiation.

MR. ERNEST STUART, who conducted the first experiments which resulted in the application of stainless steel to the manufacture of cutlery, died at Sheffield on April 16, at the age of 62. He was a director of R. F. Moseley and Sons, at whose factory the experiments were conducted.

MR. KENNETH H. HOLLEY, assistant labour manager at the Billingham works of Imperial Chemical Industries, Ltd., has been appointed group labour manager at I.C.I. (Lime), Ltd., Buxton. He will take up his post shortly. He has been presented with a gold watch by the Billingham labour department.

LIEUT.-COLONEL J. H. M. GREENLY has been elected chairman of the British Non-Ferrous Metals Research Association in succession to the late Mr. Thomas Bolton. Col. Greenly, deputy chairman of Babcock and Wilcox, Ltd., has been closely connected with the non-ferrous metals industry since 1920 and with the Research Association since 1925, and has served as a member of council almost continuously throughout the latter period.

British Association of Chemists

Annual Meetings of London and Liverpool Sections

THE annual meeting of the Liverpool Section of the British Association of Chemists was held on April 14, when the vice-chairman, Mr. C. A. Wylie, took the chair in the unavoidable absence of the chairman, Mr. G. C. Riley.

Mr. E. Myer, hon. secretary, reported that the membership stood at 191, the same figure as the previous year. During the year ten new members were elected, seven members resigned, six members were transferred to other districts and three members were transferred to Liverpool from other districts. The membership figures included 164 full members, 21 probationary members, three student members, and three honorary student members. It was stated that the committee had had under consideration a hospital service scheme.

It was announced that Professor E. C. C. Baly was retiring from the chair of inorganic chemistry at Liverpool University in September.

The following officers were elected: Chairman, Mr. W. S. Reid; vice-chairmen, Messrs. H. P. Minton and M. Rosebery; hon. treasurer, Dr. F. W. Kay; hon. secretary Mr. E. Myer.

The 19th annual meeting of the London Section was held at the Broad Street Station Restaurant on April 16.

Miss W. Wright, hon. secretary, presented the report which stated that the present membership was 888, and that during the year 37 names had been removed from the London register, including six transferred to other sections. There had been a net increase of 23 for the year. Attention was called to the special aid fund for the assistance of members, and it was stated that the council was anxious to build up a special reserve fund so that it could give material help in case of necessity, especially in the event of a "test" legal case becoming necessary.

Capt. R. P. Porter, hon. treasurer, in presenting the accounts, said that whilst London was entitled to a substantial allocation for expenses, it had not been found necessary to draw the full amount, although a considerable amount of work had been carried out during the year.

The following officers were elected: Chairman, Mr. G. T. Gurr; hon. secretary, Miss W. Wright; assistant hon. secretary, Mr. W. Littlejohn; hon. treasurer, Mr. W. F. Pavitt; committee, Mr. W. Garvie, Mr. E. A. C. Graham, Dr. A. W. Barrett, and Capt. R. P. Porter.

Lt.-Col. H. G. MacGeorge gave an address on "Some Principles of Protection in Air Raids." He discussed incendiary, gas and high explosive bombs and pointed out that the small Kilo bomb was likely to be used more than the heavy types, a large aeroplane being able to carry 2,000 of these bombs, which, if filled with thermit, burned from 7 to 10 minutes. Unfortunately, no known means of extinguishing these bombs had been discovered and the provision of dry earth or sand was the only precaution which could be taken to smother the fire. With regard to gas bombs, a remedy was a gas-proof room and use of respirators.

Foreign Chemical Notes

Japan

THE PRICE OF REFINED CAMPHOR will shortly be raised by ten yen per kilo.

Latvia

A SECOND CELLULOSE FACTORY is to be established by the Latvian Government, since the first is so busy with the home demand, that export markets have had to be neglected.

Switzerland

THE ALUMINIUM INDUSTRY A.G., of Neuhausen, announces a dividend of 7.5 per cent. (6.4 per cent. previously) on the 60 million francs of share capital for the trading year 1936. Favourable market conditions enabled the aluminium refineries to work to full capacity, although selling prices were not raised.

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Institute of Chemistry

Liverpool and North-Western Section

MR. G. BREARLEY gave an address on "Let's Go Somewhere," to members of the Liverpool and North-Western Section of the Institute of Chemistry at Liverpool on April 8. Mr. L. V. Cocks, chairman, presided.

Mr. Brearley said the rapid increase in the number of chemists engaged in industry would result in more becoming concerned with the purely commercial side of the business. A noticeable result of the chemist's activities beyond the strict application of his own science had been the creation of such qualifying titles as "physical chemist," and "chemical engineer." Although at present it would appear that a qualifying title denoted specialisation, actually it indicated the exercising of a dual function.

The following were elected for the 1937-38 session:—Chairman, Mr. A. W. M. Wintle; vice-chairman, Mr. L. V. Cocks; hon. treasurer, Professor W. H. Roberts; hon. secretary, Mr. G. W. Beaumont; hon. assistant secretary, Mr. J. F. Hardwick. Committee: Professor C. O. Bannister, Dr. W. F. Higgins, Mr. B. D. W. Luff, and Mr. B. D. Williams.

Oil and Colour Chemists

Manchester Section Annual Meeting

THE annual meeting of the Manchester Section of the Oil and Colour Chemists' Association was held at Manchester on April 9, Mr. S. T. Kinsman presided. Mr. H. Gosling, hon. secretary, in his annual report, stated that the membership, at 143, showed a net increase of six.

The outstanding work of the Manchester Chemical Societies Joint Advisory Committee during the year was the formation of the Manchester Chemical Club. The committee felt that this gave the opportunity long desired for all chemists to meet together socially. The committee had suggested to the council that as the association has steadily grown during the past few years, the time was opportune to revise the constitution of the association.

Mr. H. Gosling was re-elected hon. secretary; Mr. F. Sowerbutts, hon. treasurer; Mr. J. G. Vear, hon. publication secretary; and Mr. J. Barker and Dr. M. E. D. Jarrett, members of the committee.

Members were informed that an attractive programme had been arranged for the annual conference to be held at Buxton on May 27, 28 and 29, and the headquarters of the association expected a strong representation from Manchester.

From Week to Week

THE NAME of G. L. Products, Ltd., has been changed to Rapidex, Ltd.

THE NOMINAL CAPITAL of the British Gas Purifying Materials Co., Ltd., Leicester, has been increased by the addition of £7,500 in £1 ordinary shares, beyond the registered capital of £7,500.

RECENT RUMOURS that Cerebos, Ltd., is to take over the Salt Union, Ltd., are without foundation, although it is believed that discussions between the two companies took place some time ago.

SHEFFIELD UNIVERSITY APPEAL FUND is to receive an additional £10,000 from Sir Robert Hadfield, chairman of Hadfields, Ltd. The appeal is for at least £250,000 to increase the University's endowments, and provide necessary extensions.

THE CONSTRUCTION of a munitions factory in the Irish Free State is to be undertaken shortly. Plans and specifications have been prepared for some time, and it is understood that English and Continental firms have been asked to submit estimates to the Department of Defence.

THE BRITISH CHEMICAL PLANT MANUFACTURERS' ASSOCIATION has published in booklet form a report of the address on the Factories Bill, 1937, by Mr. D. R. Wilson, chief inspector of factories, and the discussion which ensued, at the recent annual dinner of the Association. Copies are obtainable from the Association at 1s. each.

THE ADVANCES MADE IN SCIENTIFIC WELDING METHODS during recent years are shown in a profusely illustrated booklet just published by Barimar, Ltd., under the title of "Scientific Welding Repairs to Industrial Machinery." This booklet is timely in view of the increasing difficulty in obtaining many replacements promptly and cheaply. A copy can be had upon application to Barimar, Ltd., 14/18 Lamb's Conduit Street, London, W.C.1.

The Chemical Age Lawn Tennis Tournament

Entries close May 4

ONLY nine days remain in which to enter for THE CHEMICAL AGE Lawn Tennis Tournament, details of which were published last week. The tournament, for which there is no entrance fee, comprises men's singles and doubles, open to members of the chemical industry throughout Great Britain, either as principals or members of staffs. THE CHEMICAL AGE silver challenge cups are held by the winners for twelve months, and statuettes are presented outright to the winners and runners-up.

Immediate application should be made for full particulars and entry forms to The Editor, THE CHEMICAL AGE, Bouverie House, 154 Fleet Street, London, E.C.4. (Telephone: Central 3212.)

PLANS FOR THE ESTABLISHMENT AT MELBOURNE of two factories for the manufacture of synthetic ammonia and nitro cellulose, the supply of which is important in the interests of defence as well as for industrial purposes, have been announced by Lieut.-Col. Sir William Raws, chairman and managing director of Imperial Chemical Industries (Australia and New Zealand), Ltd. The factories are to cost £300,000. This subsidiary of I.C.I. was formed in October, 1936, with a capital of £2,000,000.

A SHARP RISE IN PROFITS is shown in the 1936 report of Colvilles, Ltd., the large Scottish steel combine, which recently announced a maiden dividend of 7 per cent. Plans have been drawn up for big plant extensions, which will involve a capital expenditure of approximately £2,500,000. The directors, therefore, propose to seek powers at an early date to increase the capital, and ordinary stockholders will be given the opportunity to subscribe for additional capital, if and when issued. Trading profits and revenue from properties expanded to £658,638 from £610,709.

THE CHINA CLAY TRADE for March has shown considerable improvement in shipping. In the china clay section alone there is an increase of nearly 30,000 tons compared with the first three months in 1936. China stone, although St. Austell has the monopoly for this product, has not been in great demand for some years past, and the consignments were very much lower than for the corresponding period last year. The shipping at Fowey was exceedingly brisk last month, nearly 60,000 tons of china clay being despatched, and Par showed increased activity with over 12,000 tons. Details of shipping are as follows:—Fowey, 57,991 tons china clay, 3,282 tons china stone, 3,273 tons ball clay; Par, 11,704 tons china clay, 413 tons china stone; Charlestown, 3,920 tons china clay, 79 tons china stone; Padstow, 399 tons china clay; Newham, 162 tons china clay; Plymouth, 110 tons china clay; Rail, 5,795 tons china clay, making a total of 87,128 tons against 66,046 tons for the previous month.

DERBYSHIRE COALITE CO., LTD., a subsidiary of the Low Temperature Carbonisation Co., Ltd., has increased its capital.

A £250,000 SCHEME for the erection of coke ovens at Hebburn-on-Tyne for John Bowes and Partners, Ltd., has been completed. The ovens have been lit up but will not commence the production of coke on a commercial basis until about June. In addition to coke the works will also produce sulphate of ammonia, benzole, crude tar, pitch, creosote, and anthracine. The plant will use 200,000 tons of coal per annum thereby keeping 500 miners employed. The plant will employ directly about 200 men.

THE OIL BORING PLANT of the D'Arcy Exploration Co., Ltd., a subsidiary of the Anglo-Iranian Oil Co., Ltd., is being erected at Aislaby, Whitby, at a site near Bank Farm. When the plant is ready for operation, it is estimated that it will give employment initially for about 50 men. The test will be of the most exhaustive kind, and if necessary will be continued to a depth of 5,000 feet. It is not unlikely that heavy water runs will be encountered. The selected site is about 350 feet above sea level.

Forthcoming Events

LONDON.

April 28.—Institute of Chemistry. (London and South Eastern Counties Section). Visit to Dickinson's paper mills.

April 29.—Chemical Society. Haber Memorial Lecture. Professor J. E. Coates. 8 p.m. Burlington House.

April 29.—Institute of Fuel. "New Developments in the Treatment of the Products of the Carbonisation of Coal and Oil Mixtures." A Fisher. 6 p.m. Burlington House.

April 30.—Chemical Engineering Group. Annual meeting, 6.45 p.m. Annual dinner, 7.30 p.m. "The Chemical Engineer and Industrial Planning." Sir Alexander Gibb. Waldorf Hotel.

LEEDS.

April 29.—Chemical Society. Meeting for the reading of papers. 7 p.m. Leeds University.

STOKE-ON-TRENT.

April 27.—Ceramic Society. Annual general meeting. 7.30 p.m. North Staffordshire Technical College, Stoke-on-Trent.

Company News

Lactagol.—An interim of 2½ per cent., less tax, on ordinary in respect of year ending September 30, 1937 (same), is payable May 15, 1937.

German Dye Trust.—A dividend of 7 per cent. for the past year, the same as that for 1935, is announced. The net profit for the year was Rm.55,000,000, against Rm.51,000,000. The annual meeting will be held on May 8.

Sandoz Chemical Works, Basle.—The directors will recommend to the general meeting on May 5 an unchanged dividend of 20 per cent. for 1936. It is further proposed to pay a bonus amounting to 100f. on each share of 1,000f.

Rio Tinto Co.—The directors recommend the payment on May 15 of a final half-year's dividend for 1936 on the 5 per cent. preference shares of 2s. 6d. per share, less tax, carrying forward a surplus of about £451,775.

J. and J. Colman.—The directors have decided to recommend a final dividend of 10 per cent. and a bonus dividend of 1 per cent., making 15 per cent. and a bonus of 1 per cent. for the year 1936, the same as last year, payable on May 1.

C. and W. Walker.—The report for the year to January 31 last shows profit £30,835 (£8,935); add £1,631 brought in, making £32,465. The ordinary dividend is 10 per cent., less tax (5 per cent., tax free), plus bonus 7½ per cent., less tax (nil); to general reserve £7,500; forward £5,289.

English Clays Lovering Pochin.—A final dividend on 5½ per cent. cumulative first preference for half-year to March 31, 1937, at 5½ per cent. per annum, less tax, payable May 1 is announced. The dividend on 7 per cent. cumulative second preference for half-year to March 31, 1937, at 7 per cent. per annum, less tax, is also payable May 1.

Murex.—The directors have declared an interim dividend of 1s. 6d. per share, or 7½ per cent., on the £1 ordinary shares, less tax at the standard rate in force for 1937-38, payable May 8, 1937, on account of the year ending June 30, 1937. This dividend compares with 2s., or 10 per cent., last year, but is payable on the increased ordinary capital, *i.e.*, 1,000,000 ordinary shares as against 553,500 shares last year. Total dividend on the 553,500 shares for 1935-36 was 5s. a share, less tax, or 25 per cent. In addition a capital bonus of 66⅔ per cent. was distributed. In 1934-35 the total dividend was 20 per cent. and a capital bonus of 2½ per cent.

Chemical Trade Inquiries

The following trade inquiries are abstracted from the "Board of Trade Journal." Names and addresses may be obtained from the Department of Overseas Trade (Development and Intelligence), 35 Old Queen Street, London, S.W.1 (quote reference number).

Finland.—A firm of agents established at Helsingfors wishes to obtain the representation, on a commission basis, of United Kingdom manufacturers of chloride of lime, rosin, talc, sulphur and sulphate of soda. (Ref. No. 93.)

Egypt.—The Commercial Counsellor to H.M. Embassy at Cairo reports that the Egyptian Ministry of Public Health is calling for tenders, to be presented in Cairo by May 26, 1937, for the supply of 105 metric tons of disinfectant fluid for general purposes and 14,000 kilos of disinfectant fluid for medicinal purposes. (Ref. T.Y. 2501.)

British India.—The Director-General, India Store Department, Belvedere Road, Lambeth, London, S.E.1, invites tenders for paint, ready mixed; 40 tons white zinc; 18 tons red roofing, etc. Tenders due on May 4, 1937. Forms of tender obtainable from the above at a fee (which will not be returned) of 5s.

Stocks and Shares

THE industrial section of the Stock Exchange developed a much stronger tendency, largely owing to the removal of uncertainty regarding the provisions of the Budget. Sentiment was, however, still affected to some extent by the failure of metal and commodity prices to show any strong recovery from their recent sharp reaction. There were numerous individual features of interest among shares of companies connected with the chemical and kindred trades. Imperial Chemical have risen on the week from 37s. 6d. to 40s., and were reported to be more active than for some time, the excellent impression created by the report having brought in buyers. Unilever was another share to be influenced favourably by the report for the past year.

Salt Union have been a strong feature owing to a revival of talk in the market that the company might be concerned in a merger or working agreement with some other concern, but confirmation of this rumour is lacking. Last week the shares rose 5s. to 45s. and this week they touched 50s., but at the time of writing there has been a partial reaction to 48s. 9d. Turner and Newall were in larger demand on hopes of an increase in the interim dividend and are 103s. 3d., compared with 101s. 9d. a week ago. United Molasses also benefited from the possibility of a larger interim dividend and have risen on the week from 32s. to 33s. 9d. Some market men are budgeting for a total payment of 20 per cent. for the year, but it is realised that a great deal will depend on the trend in tanker freight rates. Borax Consolidated was another share which participated in the better tendency, there having been an improvement to 32s. 6d., at which a satisfactory yield is offered on the basis of last year's 7½ per cent. dividend.

Iron, steel and kindred shares benefited from the belief that no serious labour troubles are likely in the coal trade. Consett Iron improved favourably and Staveley, Stanton, Richard Thomas, Dorman Long, Baldwins, and Guest Keen were among shares which showed a firmer tendency. The market is budgeting for a moderately larger dividend from the last-named, it being pointed out that the company's results will benefit from the initial dividend declared by British (Guest Keen Baldwins) Iron and Steel earlier in the year. Colvilles were also better; although the large additions to plant projected by the company will need additional capital it has been announced that as and when capital is required shareholders will have the offer of shares on favourable terms. Tube Investments were bought on the possibility of a larger interim dividend and a higher price was made by Stewarts and Lloyds in advance of publication of the full results.

British Drug Houses were 22s. 3d., against 21s. 9d. a week ago, it being pointed out that on the basis of last year's profits actual earnings on the shares exceeded 11 per cent., so that the larger dividend of 6 per cent. is a conservative payment. Metal Box shares have been firmer in response to favourable dividend estimates. British Industrial Plastics at 3s. 1½d., British Glues at 9s. 9d., and Greeff Chemicals Holdings at 9s. 10½d., were the same as a week ago.

United Glass Bottle were active around 54s. Courtaulds and other rayon shares were more active on continued talk of an increase in the price of rayon, and textile shares generally received more attention. Oil shares fluctuated despite the favourable dividend estimates current in the market.

New Companies Registered

International Electrolytic Plant Co., Ltd.—Registered April 12. Nominal capital £100. Chemical, electrical, mechanical and consulting engineers and contractors, electricians, welders and manufacturers of electrolytic and electrical implements and other machinery, etc. Subscribers: A. Edgar Knowles, "Benarba," Dulwich Common, S.E.26, and N. T. Foley.

Prices of Chemical Products

THERE are no price changes to report in the London markets for general heavy chemicals, wood distillation products, coal tar products, pharmaceutical and photographic chemicals, perfumery chemicals, essential oils and intermediates. In the rubber chemical market the price of cadmium sulphide has been advanced by 1s. per lb. With the exception of the products mentioned below, all prices remain as reported in THE CHEMICAL AGE last week (pages 350-351.)

MANCHESTER.—Continued pronounced weakness in all sections of the market for non-ferrous metals since last report has again left its mark on the lead and copper products, prices of which on the Manchester chemical market are still much lower than they were a week ago. In most other respects, however, chemical products maintain a steady front and there is no lack of confidence so far as the general price outlook is concerned. The demand on the Manchester market during the past week has been on a moderate scale and, generally speaking, satisfactory reports continue to be forthcoming regarding the movement into consumption against contracts, with textile chemicals still showing some measure of improvement. In the by-products market values of most descriptions are on a firm basis and a steady trade is reported.

GLASGOW.—Business in chemicals for home trade has been rather quiet during the week, and export business also has been limited. Prices generally continue firm at about previous figures, though lead products are again easier on account of the lower metal prices. Trading conditions in coal tar products continue very steady. Fresh business in standard creosote has been booked at 5¾d. per gallon naked at works. Motor benzol is selling round 1s. 4½d., while crude benzol is realising a fraction above or below 10d. per gallon according to quality. Pitch is reported a little firmer, and clyde dock returns show a fairly large tonnage moving for export. A brisk demand continues for cresylic and carbolic acids of all grades, but in the absence of fresh transactions of any moment, prices are quoted as for last week. There is a general feeling, however, that fresh supplies will command a still greater return.

General Chemicals

LEAD ACETATE.—LONDON: White, £35 10s. per ton; brown, £35. GLASGOW: White crystals, £34 to £35; brown, £1 per ton less. MANCHESTER: White, £36; brown, £35 10s.

LEAD NITRATE.—£39 per ton.

LEAD, RED.—SCOTLAND: £39 10s. per ton, less 2½%, carriage paid for 2-ton lots.

LEAD (WHITE SUGAR OF).—GLASGOW: £38 10s. per ton net, ex store.

LITHARGE.—SCOTLAND: Ground, £39 10s. per ton, less 2½%, carriage paid for 2 ton lots.

POTASSIUM CHLORATE.—£36 7s. 6d. per ton. GLASGOW: 4¼d. per lb. MANCHESTER: £37 10s. per ton.

SULPHATE OF COPPER.—£20 per ton, less 2%, in casks. MANCHESTER: £23 10s. per ton f.o.b. SCOTLAND: £25 per ton less 5%, Liverpool, in casks.

Rubber Chemicals

CADMIUM SULPHIDE.—7s. to 7s. 3d. per lb.

Coal Tar Products

ACID, CARBOLIC.—Crystals, 6¾d. to 7¼d. per lb.; crude, 60's, 3s. 5d. to 3s. 8d. per gal. MANCHESTER: Crystals, 7¼d. per lb.; crude 3s. 7d. per gal. GLASGOW: Crude, 60's, 3s. 2d. to 3s. 8d. per gal.; distilled, 60's, 4s. to 4s. 3d.

PITCH.—Medium, soft, 36s. to 37s. per ton, in bulk at makers' works. MANCHESTER: 35s. f.o.b., East Coast. GLASGOW: f.o.b. Glasgow, 28s. 6d. to 35s. per ton; in bulk for home trade, 32s. 6d.

Books Received

The Newer Alchemy. By Lord Rutherford. Cambridge: The University Press. Pp. 67. 3s. 6d.

British Chemical Abstracts: Index 1936. London: The Bureau of Chemical Abstracts. Pp. 794.

Chemistry of Food and Nutrition. By Henry C. Sherman. Fifth Edition. New York: The Macmillan Co. Pp. 640. 12s. 6d.

Bulletin of the Imperial Institute. Vol. 35. No. 1. London: Imperial Institute. Pp. 146. 2s. 6d.

Canning Practice and Control. By Osman Jones and T. W. Jones. London: Chapman and Hall. Pp. 254. 25s.

Nachweis und Bestimmung von Losungsmitteldampfen. By L. Piatti. Dresden and Leipzig: Verlag von Theodor Steinkopff. Pp. 87. RM. 6.50.

The Chemistry of Natural Products related to Phenanthrene. By L. F. Fisher. New York: The Reinhold Publishing Corporation. London: Chapman and Hall, Ltd. Pp. 456. 35s.